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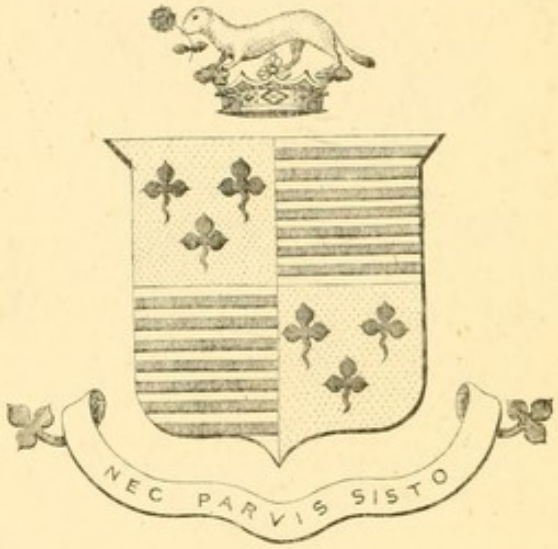

Frederick Symonds M.A.
Magd. Coll. Oxon

TUBERCULOSIS.

A

TREATISE

ON

TUBERCULOSIS,

THE

CONSTITUTIONAL ORIGIN

OF

CONSUMPTION AND SCROFULA.

BY

HENRY ANCELL,

LATE SURGEON TO THE WESTERN GENERAL DISPENSARY, AND LECTURER ON MATERIA MEDICA AND MEDICAL JURISPRUDENCE IN THE SCHOOL OF ANATOMY AND MEDICINE ADJOINING ST. GEORGE'S HOSPITAL;
AUTHOR OF "A COURSE OF LECTURES ON THE PHYSIOLOGY AND PATHOLOGY OF THE BLOOD,"
OF "COMMENTARIES ON THE DOCTRINES OF DR. JUSTUS LIEBEG," ETC. ETC. ETC.

LONDON:

LONGMAN, BROWN, GREEN & LONGMANS.

1852.

LONDON:

WM. DAVY AND SON, GILBERT STREET, OXFORD STREET.

TO

SIR JAMES CLARK, BART., M.D., F.R.S.,

Physician to the Queen and His Royal Highness Prince Albert, &c. &c. &c.

MY DEAR SIR JAMES,

The honor of being permitted to dedicate this work to you affords me the most sincere pleasure.

When I express my sense of the value of your Treatise on Pulmonary Consumption, and my obligations to you for the enlightened views which it contains, I only concur in the universal verdict given by the profession.

Since its publication immense labours have been bestowed on the subject of Tuberculous Diseases, the records of which lie scattered over a vast field of medical literature. The constitutional affection, however, which formed so prominent a part of your work, having elicited comparatively little attention from authors, it occurred to me that both the Theory and the Practice, in all the forms of Tuberculosis, might be improved, by giving to this a separate, a more systematic, and a more complete investigation.

I feel assured that it will gratify you if this work should have the effect of inducing others to look more intimately into the Origin of Tuberculous Disease, with a view to discover its real nature, and obtain a solution of some of those intricate problems, the uncertainty of which so seriously compromises the dearest interests of humanity.

I have the honor to be,

My Dear Sir James,

Your faithful and obliged Servant,

HENRY ANCELL.

PREFACE.

In bringing under the notice of the profession a work on Tuberculosis, which subject has never before been separately treated of, a brief explanation of its objects and plan will be necessary.

Nearly twelve years ago I published, in the "*Lancet*," a "Course of Lectures on the Physiology and Pathology of the Blood." At that period very little attention had been paid, in this country especially, to the diseased fluids of the human organism. About the same time, Schleiden and Schwann's cell theory was generally promulgated, and before this had been thoroughly investigated and verified, Dr. Justus Liebig's work "On Organic Chemistry in its application to Physiology and Pathology" appeared.

It was my original intention to republish those lectures as a separate work, but I felt that the phenomena of cell growth, and the doctrines contained in the "Animal Chemistry," were so remarkable, and applied so immediately to the subject of the blood, that it became absolutely necessary to pause until the voice of the profession had been heard, as to the validity of the facts and opinions which they embraced. Liebig's work was, in the first instance, not very well received in this country, and in many essential particulars he was misunderstood, even by those who undertook to review his labours. Feeling the vital importance of a just appreciation of this eminent man's discoveries, not only in a general point of view, but particularly in reference to the blood, I subsequently published, in the "*Lancet*," a series of com-

mentaries, entitled, "Liebig and his Reviewers," which were republished in Germany, and in a letter addressed to me by the professor himself, they met with his unqualified approbation.

These investigations led to the conviction, in my mind, that the Blood is of primary importance in all that relates to disease. Fully aware that many of the generalizations in Animal Chemistry attempted by Liebig have not been confirmed, I have still no hesitation in declaring my belief, that the approximation to mathematical precision aimed at, and in some instances attained, in this branch of science, combined with the discoveries effected with the microscope, including the phenomena of cell growth, and the development of some of its laws, are giving an entirely new face to theoretical medicine. At the same time, but a very limited practical application has been made of these discoveries. Teachers and writers, *ex cathedrâ,* cannot be expected very readily to reverse the doctrines which for years past have been taught in their schools by themselves or their predecessors, and the profession, as it appears to me, has by no means followed to their legitimate results the reasonings that necessarily flow from the innumerable facts which science has recently developed.

Since the publication of the Lectures on the Blood, already alluded to, which embraced a consideration of the "Pathology" of this fluid, a subject, at that time, scarcely known to science, my attention has been given to the application of the discoveries just referred to, not only to the theory of diseases but to their treatment, and I have no hesitation in stating, that the practice of medicine will be greatly improved, in all diseases, when this application has become more general. It is, however, in a large class of morbid affections of the animal economy, properly called "Diseases of the Blood," that a revision of our doctrines has become necessary, in order to place rational medicine, and especially Therapeutics, in its proper relations as respects the kindred and collateral sciences. Had my original intention been carried out, this work would have embraced the pathology of these diseases generally; but in pursuing the

subject, the preferable course appeared to be, in the first instance, to select one disease and to submit it to a more detailed enquiry.

After a patient investigation of the highly important question —the identity or non-identity of Scrofulosis and Tuberculosis— during many years, in which very favorable opportunities have been afforded me for clinical observation, by private practice and by the public appointments I have held; and after the perusal of, I believe, nearly all that has been written on the subject; I am satisfied—with Sir James Clark and the majority of the profession—that these affections are essentially the same. Observation and study have brought me also to the conviction, that the constitutional state upon which all the local developments of disease coming under these designations are engrafted, is one of those primary disorders of the blood to which I have referred. It is upon these convictions that the present work is founded.

Many valuable treatises have issued from the press, British and Foreign, during the last few years, on the subjects of Scrofula and Consumption, but there is no work, in any language, in which the constitutional affection is regarded as the primary object of theory and practice, or in which its complete history has been attempted, and a general view given of its multitudinous effects.

The object of the present work is to supply this defect. Tuberculosis, the constitutional origin of scrofula and consumption, is herein regarded, strictly, as a blood disease. I have endeavoured to collect all the most important facts relating to the physical and chemical properties of the blood, the aberrations observed in the phenomena of cell-growth and nutrition, the histology of tubercular deposits, and the special pathological anatomy of the tissues and organs, and have referred them to the primary affection as sequences or results. Those maladies which are but local manifestations of the morbid condition of the blood, as phthisis, hydrocephalus, hydrarthus, and scrofulous caries, are thus exhibited according to their natural relations, but in a novel

and more connected manner; and the whole subject is treated upon an original plan.

The importance of the subject cannot be over-rated. At a moderate calculation, according to the estimated population of the earth and the almost universal prevalence of the disease, from eighty to one hundred millions of its present inhabitants will meet with a premature death, from one form or other of the disease; it destroys annually nearly one-sixth of the population of this country; and comprises, perhaps, one-fourth of the practice of physic and surgery.

In describing this universal and fatal disease, I have given, from the best authorities, all the characteristics of the predisposition to tuberculosis, regarding them as effects of the tuberculous condition of the blood. Under this head, I fear my temerity may be blamed; I have ventured to discard the idea of the predisposition being a simple proclivity to disease, and have referred all its phenomena to the disease already existing in the blood. In the writings of those who attach the most importance to the distinction, I have no where met with a logical definition of the difference. Structural or functional peculiarities either are, or are not, the effects of the proximate or essential cause of the disease; if they do not own that origin they may act as predisposing *causes,* but they cannot constitute the tuberculous constitution or predisposition; if they *do,* they must be its effects, and, accordingly, signs of the disease itself.

In describing the signs and symptoms of tuberculosis as a confirmed disease of the blood, I have had to rely more upon my own observation and experience than in any other part of the volume. Since the discovery of the stethoscope, we have habituated ourselves, so much, to depend on the presence or absence of tubercles as the sure and only indications of the presence or absence of the constitutional disease, that we have nearly lost sight of the possibility of the existence of the one without the other; and yet, if we only watch tuberculous subjects closely, we may observe them

affected for many months or even years with the general symptoms of tuberculosis, without the slightest indication of local disease, but ultimately, dying from tubercle rapidly developed in several organs at once; or we find young persons affected with scrofulous joints, who take to their beds without a sign of internal tuberculization, but soon exhibit all the symptoms of the general disease, in its progressive form; until ultimately, tubercle is developed in the lungs, the mesentery, or other organs. So, also, it often happens, when patients present themselves for the first time with incipient tubercles in the lungs, on accurately investigating their histories, we can detect a period during which the health was deteriorated, although with a high degree of probability, and in some instances even with certainty, tubercle did not exist. I make this remark, apprised of the whole bearing of the subject of "latent" phthisis, and fully admitting its occasional occurrence.

In the chapter on etiology also, it will be observed, that I have deviated very widely from conventional usage. I must refer the reader to the views there taken, and to the arrangement of the different denominations of "causes," to form his opinion of the propriety of the course adopted. My desire has been to bring the prominent points into broad relief, to place the subject in its true light, in reference to the existing state of science, and to avoid mere theoretical disquisition. I have more especially endeavoured to discriminate between the causes of the disease of the blood and the causes of local disease; a distinction, as I think, of the utmost importance, yet hitherto little regarded and often overlooked. The work, from its nature and scope, does not include the causes of the development of local disease.

The special pathology is composed from the works of Baillie, Laennec, Andral, Carswell, Louis, Cruveilhier, Rokitansky, Hasse, Rilliett and Barthez, Lebert, and other writers. I have collated that portion of their labours which relates to tubercular affections. In the descriptions of diseased appearances, the language of the original observers is very closely followed—as closely as is

consistent with the necessary brevity and terseness—believing that to be the only way by which the correct ideas could be reproduced; but, in most instances, it has been impracticable to place these descriptions between inverted commas, owing to the necessity that has arisen for abridging them. Many may think that the work has been rendered unnecessarily bulky by introducing too much of the detail, and entering too minutely into this part of the subject; but I hold that it is most important to the practitioner to have the whole of the pathology before him. The *Post mortem* appearances test all our theories and reasonings. If anything could be shewn in the nature, the seat, or in the shades, phases, and progressive modifications of these appearances, inconsistent with the assumption, that the disease is primarily seated in the blood, then would that assumption fall to the ground.

In the chapter relating to treatment, the indications proposed are founded, strictly, on the etiology and pathology of the disease. I have purposely avoided any very general appeal to my own experience, or encumbering the work with a detailed history of cases. Although a practitioner of sufficient standing to have the family history of three generations under my immediate observation, and having, throughout a long series of years, been a too deeply interested observer of this cruel disease, I have felt, that a frequent appeal to individual experience, without that weight of authority, too often deemed essential to give the stamp of validity to medical experience, would be disregarded. Nevertheless, the practice inculcated is that which has been sanctioned by my own observation and experience.

The work which I offer to the profession then, although high in the importance of its subject, is humble as respects the pretensions of the author. I have collected materials from a great variety of sources, and have given them a totally new arrangement, founded upon a principle which has met with very general assent, but has not been previously acted upon. Under that arrangement, I have placed in the hands of the reader a great body of facts, at one

view. This, at least, if my labours in other respects should unfortunately meet with disfavour, will, I trust, be found useful to those who, with a higher degree of competency and better opportunities of advancing the science of medicine, may follow in my footsteps. Many men of genius and industry are now engaged in original investigations, with the hope of obtaining a better insight into the hidden secrets of nature, or a more accurate knowledge of the phenomena and laws of vital action in health and disease; to such, the labour which a work of this nature implies, would be impracticable without interfering with pursuits more suited to their talents and more congenial to their tastes; and yet, in the investigation of questions relating to tuberculous diseases, the materials of this work are necessary to give a direction to their enquiries, and I indulge in a sanguine hope that it will prove useful in aiding their future investigations.

It is mainly with this view and to facilitate the future enquiries of others, as well as my own, that I have recorded all the more important chemical and microscopical details before me; in particular, the whole of the analyses of the blood in tuberculous diseases, and the minute anatomy and chemistry of tubercle. Regarding these as scientific facts, they are independent of any particular views according to which they may be interpreted, and of any prevailing theory of medicine. I entertain a strong feeling, that a partial reference to facts of this nature, to support particular opinions, setting aside other facts, established upon equal authority, merely because they are opposed to these opinions, is most injurious to the progress of science; and in selecting the materials for this work and transferring them to its pages, the question has never been allowed to arise, whether they militate for or against any particular doctrines.

I venture to hope also that the statistical tables will be found useful, and in particular the *nineteenth*, which exhibits a view of the prevalence of the disease in its principal forms, at all ages, and in both sexes, in this country. Notwithstanding the imper-

fection of the returns to the Registrar General, the facts developed in that table will correct some misapprehensions which very generally prevail on several important points.

To embrace the whole subject of tuberculous diseases, another volume would be necessary, describing in detail, every distinct and well defined local affection—its rational and physical signs—its causes—its diagnosis—prognosis, and—treatment. This has been accomplished in separate treatises, and in systematic works, by preceding authors. I have endeavoured to render this work complete in itself, as far as its object goes; and looking alone to the great body of facts brought into juxtaposition—apart from their theoretical arrangement—if I mistake not their value and bearing, a knowledge of them is an essential preliminary to the right understanding of the existing treatises and monographs on any of the local manifestations.

Although I have considered it necessary to give a short account of the theoretical views entertained at various periods, on the nature of the disease, I have most carefully avoided entering into any intricate discussions; confining myself, generally, to a statement of what appear to be the more obvious inferences from the facts before me. At the same time, where my own views are given, I wish it to be understood that I intend to advance nothing dogmatically. As respects the leading principle of the book, I solicit the reflecting practitioner to consider the entire body of facts, brought forward in support of it, as the development of one great question — *Is Tuberculosis herein regarded consistently with the laws of organization and the physiology of man—and the nearest approach we can at present make to a knowledge of its true nature?*

Whatever reply may be made to this question, no injury can result from the investigation. Neither the philosophy nor the practice of medicine are sufficiently stable to preclude a novel idea, to render impossible a more comprehensive theory, or to defy a more efficient and more consistent practice; and if in any attempt to reconstruct our materials, and to revise our dogmas, we fail in

reducing them to a more perfect system or to found them upon unerring principles, one advantage at least must accrue—we may detect—in the language of Lord Bacon—"what parts of the subject have been prosecuted and what omitted." The result "may be but an image in a cross way, that points out the way, but cannot go to it,"—yet, by noting "the omissions and deficiencies," the labours of others may be brought into play, new principles of medicine may be discovered, and thus—by the productions of the humblest individual—if not directly, indirectly—the great cause of human amelioration may be promoted.

Some of the more recent sources of information to which I am indebted for the materials of this work, besides those already mentioned, are—The valuable essays by Sir J. Clark, Dr. Forbes, Dr. Symonds, Dr. Joy, Dr. Cumin, and other writers in the *Cyclopædia of Practical Medicine;* the erudite articles, and particularly those relating to foreign medicine, in *The British and Foreign Medical Review;* the *Treatises on Pulmonary Consumption, and on Climate,* by Sir J. Clark; the *Compendium of Practical Medicine,* by MM. Fleury and Monneret; the works of Baudeloque, Lugol, Fournet, Lebert and Legrange, in France; that of M. Parola in Italy; and the works published since 1840, in this country, by Mr. Gilbert, Dr. Tyler Smith, Mr. Benjamin Phillips, Dr. Glover, Dr. Addison, Dr. Madden, the late Dr. Campbell, Dr. Balman, Dr. Burgess, Dr. Blakiston, Dr. Ranking, &c.

I have to express my acknowledgments for the admirable *Reports of the Registrar General.* To Col. Sykes, of the Hon. East India Company's Service, to Col. Tulloch, of the War Office, to Mr. Farr, and to my friend Dr. Richardson, I am indebted for some valuable assistance while particular parts of the work were passing through the press.

A work of this extent, embracing numerous questions upon which the widest differences of opinion exist; the facts, derived from a great variety of sources, having never before been brought

together, and the literature of which, has been almost always undertaken with a view to illustrate parts only of the subject, must necessarily be imperfect. There will be found omissions, rendered unavoidable by the length to which the various articles have extended; imperfections referrible to the very nature of the subject; and errors, for which the author is amenable. As respects the latter, I feel it due to myself to state, that the sheets have been carried through the press amid the turmoil of a laborious general practice, subjecting me to those incessant interruptions which are so inimical to literary pursuits.

If this Treatise should prove conducive to the improvement of the science or practice of medicine; either by any original suggestions it may contain; or by the more complete development of existing views; or by the assistance it may afford to other more competent labourers in the vineyard; or merely by exciting attention to important subjects of enquiry; I shall feel that my labour has not been lost, and be rewarded with the gratification which results from having contributed, however slightly, to the advancement of a science, and the good of a profession, to which I have long been devotedly attached.

Norfolk Crescent, Hyde Park,
September 1852.

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Note.—The term "*Tuberculosis*" being employed to designate the constitutional origin of all the local manifestations of Consumption and Scrofula, and "*Tubercle*" to designate a special morbid element, the word "*Tubercular*" is generally used where the presence of tubercle is intended to be implied, and the word "*Tuberculous*" where it is not; but owing to the indefinite employment of these terms by preceding writers, it has been found impracticable to adhere rigidly to any rule.

ERRATA.

PAGE	
10	For "*Fricke*" read "*Frick*" (et passim).
31	Line 1, for "*or*" read "*nor*."
117	For "*Rokitanski*" read "*Rokitansky*" (et passim).
127	For "*poussiere*" read "*poussière*."
166	Line 8 from the bottom, for "*tensity*" read "*tenuity*."
232	Line 2 from the bottom, for "*deep into*" read "*to*."
245	Line 21, for "*ever*" read "*never*."
413	Line 18, for "*became*" read "*become*."
437	Note, for "*Gal.*" read "*Gaz.*"
550	For "*Boerrhaave*" read "*Boerhaave*."
692	For "*Lush*" read "*Rush*."

ON TUBERCULOSIS.

TUBERCULOSIS is a disease which occurs in all climates, and affects a great proportion of the human race. Under every variety of locality, hygiene, and of the customs and habits of mankind, and in the different races and sexes, it is specifically the same disease. It has hitherto been referred to by writers as a cachexia or a diathesis. The first of these terms was employed by the nosologists, to designate a class, including affections of the most varied and frequently opposite characters; as, for instance, scurvy, chlorosis, leprosy, gangrene, and psora.* By more recent writers the word has been employed to designate the general symptoms attending a local disease. Sir James Clark has described the "tuberculous cachexia" as "a particular morbid condition of the system which gives rise to the deposition of tuberculous matter, on the application of certain exciting causes, which have no such an effect on a healthy system." The word "diathesis" is more indefinite; it is frequently used as indicating a state of the constitution in which a multiplication of local affections occurs. Tuberculosis is, undoubtedly, a cachexia, but many other diseases belong to the cachexiæ, and a grave theoretical and practical error may result from the use of the term, since it is sometimes made to imply that the general symptoms are produced by the local disease. It is my intention, in this work, to treat of tuberculosis, neither as a

* Vitiosus corporis habitus quoad volumen, æqualitatem, levitatem et colorem.—*Sauvages, Nos. Method. Class X.* Totius vel magnæ partis corporis habitus depravatus; sine pyrexia primaria vel neurosi.—*Cullen's Nos. Class* III.

cachexia nor as a diathesis, but as an idiopathic malady affecting the blood. I shall make the attempt, which has never been made before, to distinguish, in tuberculous diseases, between—1. The history, symptoms, and treatment of the original disease of the blood; 2. The local complications; 3. The general symptoms resulting from the local manifestations, and supervening on and complicating the original disease. Tuberculosis will therefore, in the present volume, be regarded as an idiopathic blood disease, under the following heads :—

I. The Tuberculous Predisposition.
II. The Signs and Symptoms of Tuberculosis.
III. The History of Tubercular Deposits.
IV. The Special Pathological Anatomy of Tuberculosis.
V. The Causes of Tuberculosis.
VI. The General Pathology and Essential Nature of Tuberculosis.
VII. The Forms and Varieties of Tuberculous Diseases.
VIII. The Treatment of Tuberculosis.

Should it be deemed expedient, in any future nosological arrangement, to erect the innumerable forms and varieties of tuberculous diseases into a distinct *genus*, it will be necessary to introduce a new term to designate either the genus or the species, but I consider that the present state of pathological science warrants us in the conclusion, that the whole of these forms of disease belong to one species—I see, at present, no valid ground of specific distinction. If, therefore, this single species be regarded also as a genus or family, and ranked co-ordinately with other genera of blood diseases, it will be much more convenient to invent a new generic name than to alter that which has in some measure become conventional and is by no means inappropriate as a specific appellation.

CHAPTER I.

ON THE TUBERCULOUS PREDISPOSITION.

The truth of the observation that tuberculous diseases are most likely to occur in individuals presenting certain marked peculiarities of constitution has been universally admitted, and this state of constitution has very frequently been designated the "predisposing cause" of such diseases; but the tuberculous habit, as presented to the view of the practitioner, is not simply a predisposition to be acted upon by the causes of a disease, it is an assemblage of phenomena, depending upon, and already produced by, the same cause as the signs and symptoms of the disease itself.

These phenomena consist in a very general imperfect or perverted nutrition of the various structures, and an incomplete or irregular development of the organs and parts of the animal economy, with corresponding modifications of the functions of life. They depend upon a deviation from the perfect chemico-vital constitution of the blood.

That the blood is the true starting point whence the speciality of this constitution proceeds is shown by the hereditary tendency of tuberculosis, to which we shall subsequently refer. The fecundating principle of the germ of the species is derived from the blood of one parent, and the fœtus is nourished and its organs developed from the blood of the other parent; throughout life, the proximate elements of food are necessarily reduced to a fluid form, and conveyed into the blood, where they are assimilated and converted to its own nature before they are fitted for nutrition; æration, decarbonization, and other processes of depuration and transformation of the elements of nutrition take place in the blood, by which, in health, this fluid is continually renewed and fitted for the production of a perfect blastema for the growth and renovation of all the animal structures; the aberrations of nutrition, therefore, and the imperfect development of the various parts of the frame, exhibited in the tuberculous predisposition, are properly regarded as secondary to some modification of the vital blood. We proceed, accordingly, in the first place, to consider our knowledge as respects the state of the blood in this constitution.

SECTION I.

THE BLOOD IN THE TUBERCULOUS PREDISPOSITION.

Pathological chemistry has not at present developed the special character of blood diseases. In the actual state of science, we are scarcely justified in the expectation that the differential constitution of so complex a fluid, and the variations in quality of its constituent parts, will be so far ascertained as to lead to the discovery of their essential nature. Our powers of observation, aided by the instruments of science, have enabled us, at present, to determine very little more respecting its pathology than—certain well-marked deviations from its ordinary physical properties—the chemical constitution and the proportional quantities of some of its more important constituents and products—the occasional admixture or combination of heterogeneous materials—a few of the more obvious microscopical phenomena—with a very slight insight indeed at the laws by which its changes are governed. Nevertheless, analysis has developed many facts, and we have been enabled to arrive at certain general conclusions, of more or less importance, as to its condition in many diseases; and, as respects tuberculosis, in its various phases and stages, not only has no doubt been left that the chemical and physiological standard of the blood is very widely departed from, but some of the characters which mark its diseased condition have been very clearly ascertained.

For the purpose of forming an opinion of the condition of the blood in the tuberculous predisposition, I shall recite the observations which have been made on the physical properties of blood drawn from a vein—the appearances said to be presented on inspection with the aid of the microscope—and the chemical analyses of blood, in cases of scrofula, and in *incipient* cases of those varieties of tuberculosis which result from the local deposit of tubercle; as in phthisis. The whole of the analyses have been recorded since the publication of my lectures on the blood,* and their introduction in this place is the more important, since it will be necessary to refer to them repeatedly in the course of the present work.

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* The *Lancet*, 1839—1840.

(a) *The Physical Properties of Venous Blood in Scrofula and Incipient Phthisis.*—It is much to be regretted that we possess but few direct observations relating to the properties of the blood in the predisposition to tuberculous diseases before local disease has declared itself. Many writers, as Baumes, Denis and others, state, that they have observed, in scrofulous subjects, that the constituents are less intimately mixed than usual; that coagulation takes place readily, but the clot is small in proportion to the serum; and that the contractility of the clot is also imperfect, and hence is soft and feeble, and may even be diffluent, returning generally to its fluid state. Dubois (d'Amiens) gives a similar description; but he states that coagulation takes place slowly, and that the serum itself is more aqueous, and accordingly of lesser density.

As respects incipient phthisis, Andral affirms that the clot is small, but sufficiently dense. The serum is described by some observers, not only as being in large proportion to the clot, but as deficient in colouring matter, and by Dubois and others, as occasionally tinged with the red colouring matter. Sydenham, Boerhaave, Beddoes, Burdoch, Parr, and other writers remark, that, in individuals of a scrofulous and consumptive habit, the blood is brighter and more of a vermillion tint than natural. I do not find the remark repeated by the most recent writers; but in those conditions of the system in which it exhibits a very different tint, as in many chronic states and in advancing age, where it retains in some measure its venous character, tuberculosis becomes less frequent; and in *cyanosis,* in which there appears to be an exemption from tuberculous disease, the blue tint may be taken as a visible sign of a state of blood totally differing from, if not absolutely opposed to, that which obtains in tuberculosis.

Assuming the characters here described, from the appearances presented by venous blood drawn from subjects more or less affected with local disease to have been correctly observed, we have to estimate how far they depend upon the original disease of the blood, and how far upon the super-induced local affection. The discrepancies in the statements of different pathologists relating to the degree of contractility of the clot most likely arise from the modified fibrinous condition which attends local and general inflammatory action. Andral explains the firmness

he observed in the clot of blood drawn in the early stage of phthisis on this principle, there being a diminution of corpuscles, and a normal or an increased proportion of fibrine. Making allowance for the latter circumstance, and appealing to my own observations for many years past of the physical state of the blood when drawn from tuberculous subjects, I consider that it unequivocally indicates a low degree of plasticity in the liquor sanguinis, depending upon a diminution of the fibrine-producing power, and a degraded condition of the fibrine itself.

(b) *The Microscopical Characters of Blood in Scrofula and Incipient Tuberculous Disease.*—Dubois made numerous observations on the microscopic characters presented by the venous and capillary blood of scrofulous and tuberculous subjects.* According to his description, the colouring matter frequently appeared as if extravasated and separated from or adhering loosely to the corpuscles. When the serum was of a rose colour, which frequently happened, the serum and corpuscles presented the same tint; but when the serum was very limpid, and the clot of a deep colour, the colouring matter appeared to be stretched in layers, sometimes isolated and at a distance from the corpuscles, or sometimes confounded with them. He constantly found both spheroidal and lenticular corpuscles, their volume not being sensibly diminished, and the former presenting no peculiarity, but the latter manifestly altered in form; some having a circular point at the centre, so transparent as to make them appear perforated, resembling wheels, others being irregularly circular, or elongated and notched. Arterial blood, which he once examined, did not differ materially in these characters.

Lebert† states, that in tuberculous and scrofulous subjects, he sometimes observed the corpuscles of a lighter colour and less regular formation than usual, but he places very little reliance on these microscopical observations, and remarks very forcibly on their inconstancy and general vagueness, on the difficulty of appreciating minute shades of colour, and on the peculiarities observed not specially characterising tuberculous affections, but occurring also in other diseased states of the blood. Mr. Nicolson,

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* "Dictionnaire de Médicine," t. xxviii., p. 224.

† "Traité Pratique des Maladies Scrofuleuses et Tuberculeuses," p. 32.

however, affirms, that in scrofula the corpuscles under the microscope are lighter-coloured and irregular, their circumference being, as it were, notched and divided. Mr. Phillips * found the colouring matter apparently dissolved in the serum, but it was usually after the blood had been drawn several hours; and he regards it as a consequence of a disposition to early decomposition; and lastly, Dr. Glover found the blood corpuscles altered in form in some cases of scrofula, viz., irregular in their outline, star-shaped, and sometimes studded with granules, but he does not consider the appearance abnormal.†

Nasse and Popp state that there is an increase in the quantities of colourless corpuscles in tuberculous blood, and they observed the same thing in pneumonia.‡

My own observations of the blood corpuscles of tuberculous subjects before local disease is established are by no means numerous, but they have led me to the conclusion that they are paler and of a less regular outline, and much more readily compressed into anomalous forms than the corpuscles of healthier blood.

(c) *The Chemical Constituents of Venous Blood in Scrofula and Incipient Tuberculous Diseases.* — No investigations have been undertaken with the specific object of determining the chemical composition of blood in the tuberculous predisposition simply. The analyses hitherto recorded have been made in states of the system wherein something more than a predisposition existed, as, for instance, in confirmed cases of scrofula, and in cases where phthisis, as a local disease, had unequivocally declared itself. The predisposition to tuberculosis and phthisis is, however, regarded by most pathologists as no other than scrofula, and a reasonable inference may be drawn, that in cases of phthisis, during the period in which tubercles remain in a crude state, the blood from which the tubercle was derived was simply tuberculous; that is to say, but little or not at all complicated with those modifications which, it will be afterwards shown, result from the local development of tubercles. In the absence of direct investigation, then, the state of the blood in scrofula generally, where hectic

* On Scrofula, 1846, p. 57.

† "On the Pathology and Treatment of Scrofula," 1846, p. 118, note.

‡ Dr. Ranking's Half-yearly Abstract of the Medical Sciences, vol. iii., p. 306.

fever does not exist, and in tuberculosis at the earliest possible period after the development of tubercles in an organ, would enable us to infer, with considerable probability, the characters which it presents in the tuberculous predisposition.

In Scrofula.—1. *Mr. Nicolson's Analyses.*—Mr. Nicolson subjected to analysis a vast number of specimens of blood taken from patients in every stage of scrofula, and published the following table, as representing the averages of all his examinations. * For the purpose of comparison, I have affixed the mean of these averages, and also the generally admitted standard for healthy blood.

No.	Corpuscles.	Fibrine.	Dissolved substances in serum.	Water.
1	101	3	79·5	816·5
2	98	2·8	79	820·2
3	98	2·4	79·1	820·5
4	97	3	79	821
5	96·5	2·5	78	823
6	80	2·3	78·7	839
7	79	2	79	840
8	79	2	80	839
9	63·5	1·2	80	855·3
10	64	1·8	79	855·2
11	65·5	1·7	78·5	854·3
12	64	2	79	855
THE MEAN OF THE ABOVE AVERAGES.				
	82·12	2·22	79·06	836·6
THE PHYSIOLOGICAL STANDARD.				
	127·426	2·952	78·244	791·378

2. *Mr. Phillips*—In an examination of 67 cases found the proportion of corpuscles diminished; in a few cases the fibrine exceeded, but in many more was below the healthy standard; the albumen and salts were in most instances in excess, and the latter in some cases nearly double.

3. *Dr. Glover's Analyses.*—These analyses have manifestly been made with great care. They are described *in extenso* in Dr. Glover's work,† but I have reduced them to a tabular form, as more convenient for reference and comparison.

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* The Northern Journal of Medicine, Nov. 1845.

† *Lib. cit.*

Constituents of the Blood, according to the Analyses of Dr. Glover, in Eighteen Cases of various Forms of Local Disease regarded as Scrofula.

No.	Sex.	Age.	Case.	Water.	Solids.	Fibrine.	Solids of Serum.	Organic.	Salts by incineration.	Corpuscles.	Fats.	Spirit Extract.	Water Extract.
1	M.	15	Ulcerated Glands	816·40	183· 60=1000	4· 30	79· 30=73·90		5·40	100· 0	—	—	—
2	M.	14	Hypertrophied Glands, Diseased Bone, &c.	803·44	196· 56=1000	4·	90. 19=84·43		5·76	102· 37	—	—	—
3	M.	13	Lupus Vorax...	790·00	210· 00=1000	3· 50	87. 00=80·40		6.60	119· 50	—	—	—
4	M.	16	Scrofulous Cervical Glands	798·00	202· 00=1000	3·	99· 70=94.70		5·	99· 30	—	—	—
5	M.	33	Do. Do.	804·86	195· 14=1000	1· 30	90· 20=83·20		7.	103· 64	—	—	—
6	M.	16	Do. Do.	776·13	223· 87=1000	1· 44	89· 41=83·32		6.09	133· 02	3·51	—	—
7	M.	30	Enlarged Glands, Suppurating	784·59	215·410=1000	3.720	79·690=73·19		6· 5	132·100	4·90	—	—
8	M.	34	Scrofulous Swellings of Neck	794·09	205· 1=1000	4· 5	79· 6=73· 1		6· 5	121.	·8	·2	7·8
9	M.	20	Scrofulous Swelling...	806·00	194· 0=1000	2· 1	89· 8=83· 5		6. 3	102· 1	—	—	—
10	M.	25	Swelled Glands, Cicatrices	773·01	226· 9=1000	2· 6	87· 30=80·75		6.55	137·	4·30	2·	6·1
11	M.		Scrofulous Glands of Neck	764·01	235· 99=1000	4·	91· 50=84·70		6.80	140· 49	—	—	—
			Mean	791·94	208· 05=1000	3·132	87· 60=81·38		6·22	117· 32	—	—	—
12	F.	29	Scrofulous Impetigo and Diseased Bone...	785· 4	214· 6=1000	3. 3	101· 30=94·06		7·24	110.	—	—	—
13	F.	29	Scrofulous Tumour of Breast	824· 2	175· 8=1000	4· 7	68· 6=62· 1		6· 5	102· 5	—	—	—
14	F.	21	Diseased Bones	781·94	218· 06=1000	3· 51	93· 60=86·12		7·48	120· 95	—	—	—
15	F.	37	Swellings of Neck and Axilla	794·20	205· 80=1000	4· 5	91· 78=85·18		6·60	109· 52	1·48	—	—
16	F.	24	Swellings and Ulcers of Neck	807·49	192· 51=1000	3· 3	69· 42=63·20		5·82	119· 79	—	—	—
17	F.	19	Scrofulous Swellings of Neck	783· 7	216· 3=1000	2· 2	87· 6=81· 2		6· 4	126· 5	—	—	—
18	F.	18	Goitre...	819·34	180· 66=1000	2· 73	89· 30=82·43		6·87	88· 63	—	—	—
			Mean	795·18	200· 53=	3· 46	85· 94=79·18		6·70	111· 12	—	—	—

There are a few isolated observations by different individuals—for instance—Professor Shultz states that, "The blood being alkaline in its healthy state, and two drops of acetous acid neutralizing a drachm of serum, he found the serum in one scrofulous subject quite neutral; and in another scrofulous subject, one drop of acetous acid neutralized four drachms of serum,"—so that in this single case it appears to have been less alkaline than natural.

In Incipient Phthisis.—There are numerous analyses of the blood in phthisis, by chemists of the highest character; but these have nearly all been made with this fluid derived from phthisical subjects in the advancing stages of that disease, and are accordingly of little avail to assist us in determining its state in the same subjects before disease of the lungs occurs. It is only necessary, at present, to introduce or refer to the few which have been made, expressly, with blood from individuals in whom tubercles existed in an incipient state, since it is from these alone that we can draw an inference as to its condition in the constitutional affection which precedes the deposit of tubercles in the lungs and other organs.

Dr. Fricke, of Baltimore,* analysed the blood in eight cases of pulmonary tubercles, in four of which they were in a crude state. I introduce these four cases, with their mean proportion, and have appended the standard, adopted by the same author, of the blood in health.

No. of cases.	Solids in 1000 grains	Water in 1000 grains	Fibrine.	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	4·822	·874

We have, in the next place, the analyses published by Andral and Gavarret.† In six patients, affected with crude tubercles in the

* The American Quarterly Journal of the Medical Sciences.

† Essai de Hematologie Pathologique, Paris, 1843, p. 164.

lungs, uncomplicated with any other affection, Andral found that the proportion of fibrine varied from 2·7-1000ths to 3·5-1000ths, which, according to the standard adopted by him, although rather high, is within the physiological limit. In a patient who died of tubercles in the membranes of the brain, without any inflammatory complication, the proportion of fibrine in the blood was, upon one occasion, 3-1000ths, and upon another 3·4-1000ths. In the whole of the six patients affected with tubercles in the lungs, from the earliest period, when the existence of the local disease could scarcely be recognised, the proportion of the red corpuscles was found to be diminished. The maximum proportion of this element of the blood, in 1000 parts, being 122—the minimum 99—and the normal proportion, adopted by this pathologist, 147. In Andral's cases the red corpuscles oscillated from 100 to 120, their cypher being generally nearer the latter than the former, and in no one instance did they reach the physiological standard.

Becquerel and Rodier analysed the serum of sixteen phthisical patients;* but the blood was drawn, in all the cases, to relieve either hæmoptysis, violent febrile action, or inflammation; and, accordingly, these cases were so complicated, that the results offered no criterion of the state of the blood in the tuberculous habit, simply considered: nevertheless, these physiologists recognise a diminution of the corpuscles as constituting a part of the anæmia of this disease, and they refer the increased proportion of fibrine in tuberculous subjects to inflammatory complications.

Mr. Nicolson's Table gives, for cases of scrofula generally, a diminution of solid constituents, and a consequent increase of water, a diminution of corpuscles, and a diminution of fibrine. It is to be observed, that the cases of scrofula having been taken generally, the deviation from the healthy standard in some of the constituents most likely presents a different figure to that which would obtain if the cases were classified. This remark applies especially to the fibrine, for in all probability some of these cases were attended with more or less hectic fever, and, as it will afterwards be shown, that in hectic fever there is always an increase of fibrine, this circumstance would raise the average of the fibrine.

* Gazette Médicale, 1844.

Dr. Glover's analyses show that, in every instance, the proportion of the red corpuscles was diminished—in most of the cases, very considerably.* The solids of the serum were universally increased. The proportions of water to the solids were also generally increased. The fibrine gave an average cypher, for the males, 3·132; for the females, 3·585; but in three cases it was below the natural standard, viz., 1·36, 1·44, and 2·1. As respects the latter constituent, the same remark is applicable here as to Mr. Nicolson's results; in all the cases there was more or less local inflammation, and probably general inflammatory fever, in which the proportion of fibrine in the blood is increased. The cypher for fibrine is manifestly lower than it would be if either local inflammation of the same parts, or general inflammatory action,† occurred in individuals whose blood was previously healthy; and, I think, a careful consideration of these analyses leads inevitably to the conclusion, that in tuberculosis the proportion of fibrine in the blood is below the physiological standard. The increase of solids of the serum consists chiefly of the albumen, and very little, if at all, of the extractive matters. The fatty matters were frequently increased, although, in one instance, they were remarkably diminished, and the average amount of the salts of the serum was nearly the same as in healthy blood.

The Table drawn from Dr. Fricke indicates, for cases of incipient phthisis, a diminution of solid constituents, and a consequent increase of water; a diminution of corpuscles, and a slight diminution of fibrine. It also shows a slight increase of albumen for the whole blood, and a great increase of the same principle in proportion to the remainder of the solids in the blood; a diminution in the quantity of iron, and of the phosphates and chlorides of soda and potassa, and an increase in the quantity of lime.

From the preceding analyses, it appears that the morbid condition of the blood in tuberculosis is characterised by a deficiency in the quantity of the red corpuscles. In reference to this fact it may be called a *consumption* of the blood.‡ With respect to the albumen, it is stated by Andral—in which statement Glover, Fricke,

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* *Lib. Cit.* p. 92.

† Annales de Chimie et Physique, vol. lxxv., p. 271.

‡ Dr. Theophilus Thompson. Lancet, 1851.

and also L'Héritier and Elsner* agree—that this constituent is augmented in quantity; and several of these affirm that it is imperfectly developed and defective in quality. Andral believes that tubercular matter is never deposited until the corpuscles are diminished in quantity, and Fricke adds, "nor until the albumen is increased in proportion." The analyses and the statements of Burdoch, L'Héritier, Andral, Nicolson, Fricke, Becquerel and Rodier, and others, all lead, as it appears to me, to the conclusion, that the fibrine is below rather than above the healthy standard; and, from the loose coagulability of the blood, even where there is an absolute excess of fibrine, it may also be inferred, that this principle is defective in its nature. Some pathologists have lately maintained, that less of the fatty principle is found in this constitution than in health; and Elsner's and some other analyses confirm this view, although it is contravened by others. The increased proportion of the albumen, if it exist, by no means compensates for the diminished proportion of the corpuscles, and accordingly the water is unquestionably increased in relation to the solid constituents. Dr. Fricke's analyses indicate an increase, above the standard of health, in the lime, and a decrease in the phosphates; while L'Héritier states, that in scrofula the earthy salts are diminished. These facts relating to the salts and those recorded by Mr. Phillips are the less to be relied on, as we know that the amount of salts in the blood is rapidly increased or diminished by the ingesta, and we are in no condition to determine how far, in the cases to which they refer, the quantity had been influenced by food or medicine. Many of the observations recited in this section require confirmation or correction; but they are sufficient to enable us to arrive at the general conclusion, that the blood of tuberculous individuals, in reference to some at least of its most important principles, is degraded in quality, and that it is endowed with a low degree of vitality.

But the question more immediately requiring elucidation is, the state of the blood in that condition of the system which precedes the actual development of tubercular and scrofulous disease,—a condition attended with a great variety of structural and functional phenomena, which I purpose to describe minutely in the following

* Dr. Ranking's Half-yearly Abstract, vol. iii., p. 310.

sections. It will be made evident, that the phenomena of the tuberculous predisposition are very generally of the same nature as those observed in decided scrofulous and tuberculous disease; and it is a legitimate inference, that defects of the organisation, and deteriorated functions of the same nature, however they may differ in degree, depend upon the same cause. If the signs and symptoms of tuberculosis either depend upon, or are attended with a special morbid condition of the blood, the presumption is, that the signs of the predisposition depend upon a similar morbid condition of the blood. Although, as already intimated, most of the facts embraced in this section appertain to tuberculous subjects in a state of local disease, yet the condition of the blood in the predisposition may, on careful consideration, be inferred by allowing for any special deviation from the physiological standard, which is known to be produced by the supervention of any disease which may have presented itself in such subjects; as, for instance, the increase of fibrine which attends local and general inflammatory action. Abstracting the effects of the inflammatory action, the remaining characteristics may be presumed to belong to the general constitutional affection. The predisposition differs from the general disease only in degree, and the condition of the blood in the predisposition is the same, differing also only in degree. All observation confirms this view. In individuals enjoying comparative health, but of a tuberculous habit, the blood may not exhibit the decided deviations from its healthy condition here indicated, or, at the period of making an observation, it may even appear to be perfectly healthy; or it may exhibit the minutest shades of those deviations from health, which obtain in tuberculous affections; but at the period when the foundation of the tuberculous habit was laid, and when the structural modifications were produced, whether during intra or extra uterine existence, the blood or its embryotic analogue must have been, in a greater or less degree, tuberculous.

The following diagram, drawn from the preceding observations and analyses, exhibits at one view, what I believe to be the state of our knowledge of the blood as it circulates during life, in an individual predisposed to tuberculosis, with the resolution into its chemical constituents, when drawn from a vein.

- Tuberculous Blood defective in Vital Properties; the essential nature of the defect unknown.
  - Red Corpuscles
    - Deficient in Number.
    - Defective in structure?
      - Globulin *deficient.*
      - Hæmatin *deficient.*
      - Iron *deficient.*
  - Liquor Sanguinis
    - Vitiated in quality, producing on Chemical Analysis,
      - Water *in excess,*
      - Albumen *in excess, but defective in quality?*
      - Fibrine, *rather below than above the healthy standard, and defective in quality.*
      - Extractives?
      - Fats? *Probably deficient.*
      - Colouring matters *modified.*
      - Alkaline salts *deficient?*
      - Earthy salts *deficient?*
      - Lime *in excess?*
      - Gases?
  - White Corpuscles?

A diminished vitality thus appears to be the most general character of the blood in tuberculosis, and I terminate this section by defining the idea I attach to this expression. In living matter the degree of vitality is measured by the sum of vital actions, comprising not only chemical and physical changes produced under the influence of the vital force, but actions referrible to the vital properties of irritability and sensibility. The healthy constitution of man corresponds with a physiological range of vital actions in the blood and the living tissues, but especially in the blood. These actions, as respects the blood, consist in all the molecular changes which take place in hæmatosis. They comprise those which result from the dynamic property of endosmose and exosmose in the corpuscle, as well as those which mark—its organic contractility—the assimilation of old and new matter to the form of blood—the formation of red corpuscles and liquor sanguinis—the consumption of red corpuscles—and the waste of liquor sanguinis in nutrition. When the sum of these molecular actions is within the physiological range, and they are in harmony with each other, a sufficient number of corpuscles being formed and wasted, and all the constituents of the liquor sanguinis being atomically complete, and of normal proportion, and consumed and renovated in proportion to the requirements of the living structures, the blood has a healthy degree of vitality; but in tuberculosis the sum of these actions is below the physiological range; and, moreover, the proportions and qualities of the constituents of the blood are deranged. This marks a low

degree of vitality, which, as we shall see, is consistent with all the phenomena of the tuberculous predisposition, and with the signs and symptoms of tuberculosis in its various forms.

SECTION II.

THE STATE OF THE FLUIDS WHICH SUPPLY THE BLOOD WITH THE MATERIALS FOR ITS RENOVATION.

I. *Of the Lymph.*—Although tuberculous affections, and especially scrofula, have been allied from time immemorial with the lymphatic temperament, and the latter is now admitted by pathologists as a predisposing cause of these affections, no investigation, that I am aware of, has been made, since the recent improvements in organic chemistry and the introduction of micro-organic chemistry, as to the state of the lymph in any grade or variety of tuberculosis. Hippocrates inferred, from observation alone, that there is an excess of lymph in the scrofulous habit, the excess being diverted to the glands and the cause of their swelling and degeneration. The humoralists generally considered this insufficient to account for the phenomena, and imagined the existence of a virus, which was variously regarded as an acid,* a fixed salt, a volatile salt, a putrid or a bitter principle. Some held that any kind of acrimony in the lymphatic system might be a cause of scrofula. Very recently M. Simon has renewed the lymphatic theory of the disease which he regards as a lymph disease, this fluid containing some morbid product precipitable by the atmosphere.† These theories will be brought under consideration in a future chapter.

As to the real state of the lymph in tuberculosis, we have little more than *à priori* reasoning to guide us. A morbid condition of the blood, resulting in changes of the structural elements of the body, must be attended with some change in the qualities of this fluid. There are many facts in the history of tuberculosis—as those which relate to the extreme frequency of derangement in the lymphatic glands—which bear upon the conclusion that the lymph

* Baumes, Traité sur le Vice Scrofuleux, 1805, p. 8—15, and others.

† Lectures on General Pathology. 1850.

must be unhealthy in every grade of the disease. That tubercular matter has been found in the lymph proves nothing in favour of this fluid being uniformly or generally more viscid than natural, or more liable to concrete; since the solid matter in these instances has presented itself after the deposition of tubercle elsewhere, and in vessels proceeding from the site of the deposit. If it be difficult to determine the specific characters of morbid blood, the shades of difference in the lymph, as respects its healthy and morbid states, must be still more obscure; and, owing to the difficulty of collecting this fluid, and the nicety of the operations required to determine its physical and chemical qualities, the enquiry seems to have been neglected. At the same time, the pathologist who wishes to take a comprehensive view of such an affection as tuberculosis, pervading as it does the whole system, must not overlook the fluid constantly flowing through the lymphatic vessels.

There are no observations to determine whether the diminished proportion of the red corpuscles of the blood is attended with a diminished proportion of the corpuscles in the lymphatic vessels; the blood being less fibrinous and coagulable, and more aqueous than natural, and, as will subsequently be shown, the lymphatic vessels having probably a greater tenuity, and the cellular and fibrous tissues of the body being defective in structure, it may be inferred, perhaps correctly, that the lymph is thinner and more abundant in tuberculous subjects; and that the quantity of corpuscles which it contains, their structure and the proportion which the lymph bears to the blood, are deranged,—that, in fact, some modifications of its physical and chemico-vital qualities have much to do with the character of the disease. But, assuming that some more special modification of the liquor sanguinis exists, it remains a problem whether the lymph partakes of that speciality; although, from the frequent occurrence of disease of the lymphatic system in tuberculous habits, the existence of a corresponding diseased condition of the lymph is highly probable.

II.—*Of the Chyle.*—Most of the assumptions of the humoral pathologists respecting the morbid state of the lymph in tuberculous diseases were extended to the chyle. It will be shown as we proceed, that in the tuberculous predisposition, all the secretions essential to primary digestion, poured into the stomach and alimentary canal from the vitiated blood, are liable also to be vitiated;

but I have not more than one direct observation before me of the state of the chyle in tuberculous diseases, as compared with the chyle of the robust and healthy. Schultz describes the chyle granules as imperfectly formed, and the fluid in which they float as less plastic in scrofulous constitutions than in health.* In tuberculosis, the mesenteric like the external lymphatic glands are very frequently diseased, primary digestion is often affected, and emaciation occurs, which circumstances have led to the inference that a morbid condition of the chyle exists, and this assumption has formed the basis of some of the most prevalent theories of the disease. But this morbid condition of the chyle is inferred from tuberculosis in a state of active disease, and even Schultz's experiments are made with chyle from the subjects of fatal scrofulous disease. They do not lead us to any conclusion as to the nature and constitution of the chyle in the tuberculous *predisposition*. In the actual state of science we can only arrive at the rational inference,—bearing in mind the low degree of vitality of the blood, and the degraded constitution of the liquor sanguinis, and connecting the morbid state of the blood with certain structural defects from malnutrition of the digestive apparatus, hereafter described, which are attended with a deterioration of the qualities of those secretions essential to the digestion of food,—that the chyle is in all probability imperfectly formed in this predisposition.

The morbid conditions of the chyle and lymph observed after the death of tuberculous subjects are detailed in the chapter on the special pathology of the disease.

SECTION III.

THE BLASTEMA IN THE TUBERCULOUS PREDISPOSITION.

In the physiological state, the liquor sanguinis, during its passage through the different tissues, supplies to each a healthy blastema, liquor nutritivus, or material essential to cellular and fibrous development, growth and organization. The resources of chemistry and the use of the microscope have not enabled us to investigate the nature of this fluid, since it is difficult to isolate; and, hitherto, has in a great measure eluded our direct investigations; yet, we have

* *British and Foreign Review*, July, 1843.

reason to regard it as a protein compound; in it are probably formed the cyto-blasts, or germs of cells, from materials derived from the blood, each tissue or structure having a vital affinity for those constituent molecules, or for those cell-germs, that are appropriate for its own growth and nutrition. From this blastema the various parts of the organism are built up symmetrically, mainly from cells, and maintained in a state of vigour, for the purposes of life. That the blastema supplied to the individual tissues is liable to vary in quantity, in the proportions of its constituent parts and in other qualities, within a physiological range, is shown by individual differences of consistence, colour, form, and proportion of the whole body and of its parts. When the blood, and more particularly the liquor sanguinis, becomes deteriorated from any cause whatever, this fluid is also liable to be supplied in a modified or defective state. Although many of the humoral pathologists were aware of this, they attached to it but little importance, attributing certain peculiarities of form, colour, and consistence, occurring in particular constitutions, altogether to alterations in the quantity and quality of the lymph. Of late Gruby* has found, by direct observation, that under the influence of different forms of morbid action and diseased states of the blood, the white pellucid fluid exuded from the blood-vessels, which may be taken as the analogue of the healthy blastema, varies in its qualities, and in its constituent parts; thus, the fluid with which the skin is rendered turgid in œdema, contains white or yellowish globules with stellate points. Our knowledge of the laws of cell-growth, and of the development of the tissues from cells or otherwise, is excessively limited, but all science teaches that tney must be subject to aberrations, and modifications, from varieties in the chemical and molecular constitution of the *material* in which they are brought into play. That there may be an excess or deficiency, or an alteration of proportion, or a depravation in quality, of this fluid, is illustrated in various diseases, and the effects of these changes become manifest in the imperfect or irregular development or the morbid nutrition of the tissues, and of the organs of which they form the anatomical elements. In the tuberculous predisposition, the vitality of the blood is below the healthy standard, the corpuscles are

* *The Microscopical Journal*, 1842, p. 234.

diminished in number, the liquor sanguinis is vitiated, and in a future section it will be shewn that in no affection are the aberrations of cell development and nutrition more obvious. Therefore, although we are not in possession of any direct proof, the conclusion is inevitable, that a morbid state of the blastema, corresponding in its nature with the morbid state of the blood, prevails in this state of the constitution.

SECTION IV.

STRUCTURAL CHARACTERISTICS OF THE TUBERCULOUS PREDISPOSITION.

The characteristics of the predisposition, habit, or constitution developed from the tuberculous blastema of tuberculous blood may be further treated of as structural or functional.

A.—PECULIARITIES OF THE CELLULAR AND AREOLAR TISSUES AND THE STRUCTURES OF WHICH CELLULAR TISSUE FORMS THE ORGANIC BASIS.

The cellular tissue is unquestionably the substratum of the greater number of the animal structures, and with the pellucid basement membrane may even be regarded as "the original and common basis of all organised matter." It might be inferred, *à priori*, that the morbid blood of tuberculosis, furnishing a degraded blastema to this tissue generally, would result in malnutrition of the structures which compose the animal body; and so remarkably is this the case, that the slightest degree of the tuberculous predisposition is liable to be characterised by changes more or less universal in these structures. The following facts are drawn from the best pathologists who have written on the subject.

If we regard the *areolar tissue* in its distinct form, a close examination of well-marked cases of this particular constitution leaves no doubt of the degradation in question. When this tissue has been formed from tuberculous blood, its molecules are defective, and held together by a weak vital affinity. This is exhibited by a want of firmness and resiliency; it is soft, pulpy, and glutinous, and maintains most of the characters which it presents naturally in very young animals, or even in the embryo. Its defective structure and low vitality are exhibited by the rapidity with which absorption and deposition take place. Where it appears

to be even more than ordinarily developed, by which the delineations of the muscles are hidden, giving a roundness and plumpness to the limbs, as often occurs in children, the appearance is deceptive, and, on close investigation, will be found to depend upon an infiltration of fluids rather than the nutrition of the solids of the part. Even in cases where a full or excessive nutrition or hypertrophy occurs, the diminished firmness and resiliency, and the facility with which absorption takes place under active exertion, privation from nutriment, or disease, indicate the weakness of the nutrition. The development of cells, as of simple fibres, somewhat as in new growths and fungoid excrescences, is also degraded into a kind of vegetation. If the malnutrition takes its rise from the earliest period of embryotic life, is continued during uterine existence, and prevails to a certain degree, the *cellular tissue* may never regain its normal firmness, but may present, throughout existence, the character which it possesses in young animals; and the structures proceeding from it may never acquire that density which results from cells formed in a well-constituted blastema. These characters, apply, not only to the areolar tissue, properly so called, under the surface of the body, and enveloping the various organs, and to the adipose tissue, but to the cells which form the basis of other structures. The most important results of the weakness of cell-growth, and the imperfection of the cellular tissue, are the following:—

1. *In the Cutaneous System.*—The tegumentary membranes furnish some of the best marked and most unequivocal characters of the tuberculous constitution, and a peculiar organization of the skin especially, has, from time immemorial, been remarked as characterising those individuals who are most prone to scrofulous and other tuberculous diseases. In clearly marked cases it is found for the most part, smooth, soft, and delicate, appearing as if blanched and transparent, the blood-vessels being seen through it. This condition has been observed to be more marked in proportion as the individual has been withdrawn from the influence of light, and L. Parola * explains the circumstance by an arrest or imperfection of development of the true skin, replaced by an hypertrophy of the adipose tissue; it is frequently one of the most obvious

* *Della Tuberculosi.* 1849.

signs of the scrofulous form of the disease. The tint may be fair or dark; sometimes, particularly in children, it is of a dead white. It frequently happens that the pallor does not extend to the face, which is ruddy or rosy, or there is a pink tint of the cheek, the colour appearing as if it were laid on with a brush, forming a remarkable contrast with the dead white. In some instances the complexion is dark and puffy, the face being, as it were, inflated; and in infants and children there is often a paleness of the lips and a dirty paleness around the mouth, and frequently a slightly leaden or bluish tint under the eyes. These characters of the skin and complexion, and all the varieties which they assume, are readily explained—by the defective organisation of the cutaneous tissues, owing to the defects of cell growth already described—by the weakness and tenuity of the vessels which permeate these tissues—by the altered qualities of the blastema—the infiltrated condition of the areolar tissue—and the peculiar characters of the circulating fluids.

Some peculiarities, but far less constant, are found in the appendages to the skin which depend for their nutrition upon the skin itself. The *hair*, in many of the most unequivocal cases, is small in quantity, light coloured, and very fine or silky; but this is by no means a general characteristic: individuals with dark hair are, perhaps, equally affected with some of the varieties of the disease, as with phthisis. It has been remarked that children having their foreheads, arms, and backs covered with close-lying dark hair, the eyelashes long, curved or lying close together, associated with other signs of tuberculosis, are not only predisposed to this disease, but are sometimes "saturated with scrofula," and have a tendency to deposit tubercle in every organ of the body.

The nutrition of *the nails* is very often defective in the tuberculous predisposition, although it may not become manifest until after actual disease has set in. They have, in some cases, a tendency to become elongated, and very frequently to assume a remarkable incurvation. This appearance, which is sometimes a very significant sign of disease, has been too cursorily regarded, and has received very unphilosophical and inadequate explanations. The nails cannot properly be viewed as unorganized structures. The growth of these appendages, as of the tissues themselves, proceeds by cells, formed in a blastema derived from the blood circu-

lating in the matrix; and a defective blastema secreted from a morbid liquor sanguinis, here, as elsewhere, produces cells of weak plastic power. If the substance of the nail is in part produced by epithelium scales formed on its under surface, a defective nutrition, as respects these scales, may contribute to the effect; but the chief cause is manifestly malnutrition in the matrix, the posterior and inferior laminæ of which, being formed of fewer cells, and these being possessed of a weak plastic power, may account for the incurvation; a change of form which ultimately, when the predisposition passes into actual disease, is promoted and increased by the shrinking of the extremities of the fingers, and probably by the unequal endosmose and exosmose of the cell membrane or the too rapid evaporation of its contents,* and by a state of tension and congestion of the skin which surrounds the borders of the nails.

2. *In the Mucous Membranes.*—The mucous membranes, built up from tuberculous blood, are thin, pale, delicate, and distensible. The strata of cellular tissue, above and below them, being also defective in organization, and their abundant capillary vessels in a corresponding degree thin and distensible, they are morbidly prone, either with or without rupture, to congestion and to give passage to their contents. The state of the mucous membranes is best seen in the mouth, and especially in the gums, and from some most interesting observations recorded by M. Fredericq and Dr. Theophilus Thompson, which I shall have to describe in a future chapter, I infer that the defective organization of these membranes is frequently exemplified by a white streak at the reflected edge of the gums—a delicate, pearly, transparent aspect of the border, "probably in part the result of fineness of structure." No minute investigation has been made of the particular state of organization of the bronchial, intestinal, or generative mucous membranes; but, from the modifications of their functions, which will be described as a part of the tuberculous predisposition, there can be no doubt that the whole mucous tissue participates in the general malnutrition of the cellular structures.

The *teeth* frequently exhibit peculiarities. Camper asserted that

* *Principles of Physiology, General and Comparative*, by Dr. Carpenter, par. 179.

soundness of the teeth is a peculiar mark of the tuberculous predisposition, and other writers have repeated this observation: a milky whiteness, with a remarkably clear cast, and a denseness and compactness of texture, has thus been described amongst the less constant signs of tuberculosis; some have gone so far as to render this a distinguishing characteristic of a predisposition to phthisis especially, affirming that the greater number of persons who die of phthisis have never had a carious tooth. More modern writers state, that the peculiar organization of the teeth, in this predisposition, renders them more liable to caries; and, in particular, the first teeth are said to be small, and easily affected with this disease. We have certainly seen many cases which bear out Camper's observation, but the converse is undoubtedly also true. Most likely, the teeth present differences of organization, according to the period of life at which this predisposition is observed, as happens with some other structures. They may be prone to scrofulous caries in the young; but, escaping this, the tendency of the nutritive changes may be to render them more compact, and produce the immunity from disease sometimes observed in phthisis. We believe that caries of the teeth is more frequent now than formerly, which may be attributed to some modern customs, as the use of particular medicines or articles of diet,—the organization of the teeth, in the tuberculous predisposition during early life, rendering them more susceptible of the action of such agents.

3. *In the Vascular System.*—The vessels are thinner, more transparent, more distensible and less contractile. There is a visible tenuity of the coats of the arterial and capillary systems; the capillaries are deficient in elasticity; the veins, from the weakness of their parietes, are morbidly distensible, and liable to become more than ordinarily conspicuous, and appear to be more numerous and disseminated under the skin; nor can it be doubted, that the lymphatics partake of the general tenuity and malnutrition. Many observers affirm that the vessels of the latter system are larger and more numerous than in the natural conformation; but this appears to be a vague assertion, probably arising from their increased susceptibility of forced distension, and to their becoming visible to the naked eye.

The late Dr. Campbell made some experiments from which he came to the conclusion that the pulmonary capillaries are of

smaller dimensions in tuberculous and scrofulous subjects than in those of a healthy constitution. He injected a mixture of mutton-suet, olive oil, and vermillion into the pulmonary arteries. In cases of healthy lungs the injection passed out at the pulmonary veins of the same colour as when injected into the artery, but in tuberculous individuals, whether or not their lungs contained tubercles, the injection came out at the pulmonary veins deprived of its colouring matter.* I am not apprised that these experiments have either been refuted or confirmed, but the physical condition of the vascular system in this disease is a subject much requiring elucidation.

A most important result of the defective formation of cells regarded as the original basis of the vascular parietes, is a tendency in the vessels, together with diminished solidity of their parietes, to undue and irregular elongation; laying the foundation for many of the irregularities in the form and proportion of different parts and organs, which will be described as we proceed.

4. *In the Serous Membranes and other Structures with a Membranous and Cellular Basis.*—No special observations appear to have been made on the organization of the serous membranes in the tuberculous predisposition, but can there be any doubt that the morbid blastema is liable to occasion imperfections of structure in all the tissues which have membrane and cells for their original basis? The vascular, cutaneous, mucous, serous, adipose, ligamentous, and the animal part of the osseous tissues; all the organs built up of membrane and cells, and furnishing gelatine on analysis, give unequivocal evidence of feeble organization. There appears to be a predominance of degraded cellular structure, not only immediately under the surface of the body, and investing the tissues and organs, but in the most intimate parts of the organic structures, where it partially replaces the specific tissue. This has been designated "an arrest of development," † or "a retrograde morphology." ‡ The precise relation which the morbid state of the blood bears to this defect of organization we cannot determine, but the fact ought not to be overlooked, that within the vessels a vitiated liquor sanguinis corresponds with a diminished proportion, and probably

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* Observations on Tuberculous Consumption. 1841. p. 143. Et passim.

† Andral. ‡ Dr. Addison on Healthy and Diseased Structure. 1849.

a defective structure of red corpuscles, and without the vessels a degraded blastema corresponds with a defective cell growth, and probably a diminished proportion of cells; this double pathological condition constituting perhaps the most important phenomenon in the tuberculous predisposition.

B.—THE OSSEOUS TISSUE AND THE SKELETON.

A deviation from the normal constitution of the blood, and a consequently imperfect gelatinous and chondrinous blastema for the development and growth of bone, are necessarily liable to produce defects in the osseous system; and accordingly, an imperfection in the structure of bone and a want of symmetry in various parts of the skeleton have been described, from the period of the earliest observers, as characteristic of individuals predisposed to tuberculosis, or as incidental to the different varieties of the disease.

The changes of structure in the bones, and the modifications of the skeleton, although in many particulars very distinct, have not been philosophically investigated in reference to the actual state of science.

There is frequently a very manifest retardation of development, as shown by the bones of the head remaining separated at a period when, normally, they should be united, and by the epiphyses of other bones being isolated. The bones generally are said to be of less specific gravity than natural, and to yield a smaller proportion of earthy salts; the organization of the spongy portion is represented as defective, being softer and less compact, owing to which and to the tenuity of the coats of its vessels and their distensibility, this portion appears to be more vascular than natural. The spongy portion is also too abundant in proportion to the compact tissue and to the fibrous and ligamentous structures which surround the bones. The animal matter partakes of the general defects of organization which characterize other gelatinous and cellular structures. But very great differences present themselves in the organization of the bones according to the period of life in which their nutrition has been disturbed by a tuberculous condition of the blood and blastema. The peculiarities are most characteristic in those who possess an unquestionably hereditary taint, and they have their origin, apparently, in the blastema of

the osseous cartilages being imperfect, and the proportions of the constituents required for the formation of perfect bone being disturbed, the defect of the materials interfering with the ordinary operations of the laws of cell-growth.

Although the most marked instances of the imperfect organization and development of bones are referrible to the earlier periods of embryotic and fœtal existence, yet, when the blood becomes tuberculous in later periods of the process of ossification, the effect, although less marked, is still similar. But in after life, when the bones are completely formed, owing to the slowness with which the change of matter takes place, alterations in structure and form are much more rare. Hence, when tuberculosis, as a disease, is acquired in after life, no deviation whatever from the normal state of the skeleton may be observable. When the predisposition to tuberculosis has existed during the period of the development of the skeleton, and never passed into actual disease, the modifications in the size and form of the bones remain permanent; but it would appear that the conservative powers of nature may produce changes of structure of a reparative tendency. Thus, according to an observation of Béclard's, in tuberculous subjects who die of phthisis, the costal cartilages are frequently found ossified at an early age.*

The peculiarities of the skeleton are extremely numerous. Individuals are frequently of small stature, but occasionally they attain an unusual height; extreme cases of young persons under four feet, and as much as six feet four inches high, occur among the scrofulous. The general form is often slender, and indicates, at first sight, a deviation from the natural proportions. The head is often large, especially posteriorly, the trunk small, the joints large, and the limbs misshapen and crooked. The forehead is often irregularly developed, projecting, or low and irregular, or uneven, presenting a nodulated appearance at the various points of primary ossification. In infants a large head with a short neck, and delayed, imperfect or irregular development of the cranium generally, with or without a separation of the sutures, is frequently associated with chronic hydrocephalus and the tubercular meningitis so common in tuberculous subjects. The malar bone is often too prominent, the

* *Elements of General Anatomy*, by Dr. Knox, p. 248.

temples hollow, the jaws unusually broad, and the inferior maxillary bone elongated, with its angles projecting. Sometimes we observe a long neck and a narrowness of the chest, with elevated and projecting shoulders, and for the most part a projection of the clavicles. This narrowness of the chest, consisting especially of a diminution of size at the summit and the arches of the ribs being less convex than natural, occasioning the ribs to recede from the scapulæ, and rendering the latter unusually prominent—which has caused them to be compared with wings by most of the old authors—indicates a want of capacity in the thorax, and has from time immemorial been associated with tuberculosis pulmonalis. The chest is sometimes gibbous or keel-shaped, the divisions of the sternum being visible beneath the skin, the sternum tilted forwards, the antero-posterior exceeding the lateral diameter of the chest, and the ribs variously distorted. When the arrest of development of the chest is most marked, the elevation of the false ribs and the narrowness of the base causes the abdomen to project, and produces an extraordinary contrast between the thorax and abdomen. The spongy parts of the bodies of the vertebræ are frequently softer and less compact, the spinal apophyses enlarged, and the spine is sometimes curved; the pelvic bones are also sometimes irregularly developed; the pubis, the sacrum, and the ischia are occasionally hypertrophied; and the processes of the sacrum are frequently remarkably large. The trunk and the extremities are not proportionably developed, the limbs being too long or too short. The cylindrical bones of all the limbs are very generally more slender in their bodies than usual, and very frequently enlarged at their extremities, or the whole of the bone is large and clumsy, the cortex or outer wall being thin, and the spongy parts soft. The ankles and wrists are frequently thick, and the spongy part of the carpal and tarsal bones, and the extremities of the metatarsal and metacarpal bones thick and soft. In some cases, the feet and hands attain a disproportionate length. In children, the limbs, besides being too long or too short, present large joints, and their various parts appear to be loosely or irregularly attached to each other.

The loss of the harmonious form of the fingers, known as the Hippocratic finger, arises more especially from the successive contraction of the inferior parts of the superior phalanges,

while the opposite extremity becomes more developed and rounded, which makes an ugly contrast with the natural form. This development of the spongy parts of the phalanges has been recently commented upon by Trousseau * and Pigeaux.† It is almost exclusively peculiar to tuberculosis. Trousseau made his observations entirely on women, who have this deformity better marked than men. It is especially an attribute of hereditary tuberculosis. Fournet having rarely met with it in the hospitals in Paris, was led to think that it ought to be considered as an exceptional sign, having no direct relation with tuberculosis, the particular cause of it having escaped us.‡ But the authors first quoted remark that in these hospitals patients are not received until after fifteen years of age, and that in a city like Paris the conditions are found most favourable to the accidental production of the disease, which circumstance accounts for its frequent absence.

Fournet,§ Woillez ‖ and Hirtz have recently investigated the form and volume of the chest in tuberculosis more philosophically than had hitherto been done. There is a *general malformation* and *contraction,* sometimes originating from birth. According to Fournet, in the physiological state, the development of the summit compared with the base is in direct relation to the development of the muscular and osseous systems generally; and as respects the latter system, to the substance or thickness rather than the length of the bones. In tuberculosis, the transverse diameter, particularly at the summit, which in the well-formed chest is longer than the antero-posterior diameter, tends to diminish, by which the thorax takes first a cylindrical and ultimately a prismatic form with rounded angles, giving it in its most decided and exaggerated state a resemblance to the chest of birds. By this modification the circumference of the summit is diminished in comparison with the circumference of the base, and the thoracic cavity as a whole is diminished. In tuberculous children the shape resembles that of the fætal chest, being round and contracted superiorly, proportionately larger at the base, and accor-

* Journal des Conn. Med. Chirurg., tom. i, p. 351.

† Archiv. de Med, tom. xxix, p. 174.

‡ Recherches Cliniques, p. 408. § Lib. cit., p. 586.

‖ Recherches Pratique sur l'Inspection et la Mensuration de la Poitrine, 1838.

dingly conical; the sternum being compressed in the manner of a keel or prism, and the whole thorax raised superiorly and anteriorly.

These modifications of the chest consist in a development, frequently progressive, in an inverse relation to the natural condition, which tends to enlarge the summit. They also for the most part bear a relation to a diminished degree of vigour of the muscular and circulatory systems, and to the diminished perfection of the osseous system generally, already described; particularly as respects the degree of its solidity rather than the length of its particular parts; for it generally happens that an increased length of the phalanges, of the fore arms, and legs, corresponds with a diminished length of the ribs, a contracted transverse diameter of the chest, and a diminution of its general cavity. Then again as respects the vertical diameter: this, as a "general rule," is increased in length, bearing a proportion to the increased length of the limbs, thus again establishing a relation between the elongated chest and diminished muscular development.

It has been very generally admitted that in proportion as the chest is contracted the tuberculous predisposition is well marked; but this malformation, which is for the most part uniform on both sides, must not be confounded with that which depends upon local disease within the chest, most frequently limited to one side, or much more clearly marked on one side than on the other. The latter is symptomatic of local disease. The malformation of the chest here described depends upon the original disease of the blood; it may be very slight or very decided. When local disease occurs within the chest, the primary malformation increases from the continued operation of the original cause, and is generally very rapidly augmented and altered in some of its characters by the operation of local causes. The descriptions given by writers generally comprise in one category the whole of the modifications in their progressive course, as they occur in cases of tuberculosis pulmonalis; the description here given separates the contraction of the chest, which depends upon the original disease of the blood, from the aggravated and modified contraction which depends upon the development of tuberculous disease within the chest.

These are the peculiarities of the skeleton generally described as marking the scrofulous and consumptive habit. They are by

no means constantly present, or uniformly so in any case. In accordance with a law by which tuberculosis has a great tendency to localize itself as a disease in several places in the same individual, but not universally, the aberrations of nutrition in the osseous system, here described, are liable to present themselves in particular situations. The contraction of the chest has been laid down as the most characteristic of all the external signs, being, in the less marked cases frequently discoverable without any affection of the health of the individual, and without any other malformation. I take these aberrations of nutrition, as a whole, as characterizing the tuberculous predisposition, or that state of the habit in which one or other of the different varieties of tuberculosis are most likely to occur.

On closely examining the skeleton in the tuberculous predisposition its structure will be found to be, in a certain sense, *sui generis*. Varieties are observed in the two sexes, and in the different races of mankind to which the modifications we have described bear no resemblance. These modifications bear no analogy to the peculiarities which distinguish the Mongolian from the Ethiopian, or this from the Caucasian race. There is a certain similarity in the osseous tuberculous predisposition, as it affects different bones, which enables us to refer the peculiar malorganization to one general cause, whatever that may be. As a whole, in this predisposition the condition of the bones differs also from that of any other disease. Thus:—

The deformities resemble in some respects those which occur in rachitis, but they differ from them in other very important particulars. In the first place, although, as in tuberculosis, the bones in rachitis are more vascular than natural, their vessels being loaded with morbid blood, the blood itself manifestly differs from that of tuberculosis; it is of a brownish rather than a bright scarlet hue, and is represented by some of the older writers, who observed this disease very accurately, as entirely dissolved, so that it resembles chocolate rather than blood. Again, in tuberculosis there is not that manifest dependence upon mechanical causes as in rachitis; the modifications in the form and directions of the bones are not dependent upon the weight and pressure they have to sustain, as is obviously the case in rickets. Although, in the latter, the state of the bone

depends in a great measure upon a deficiency of earthy material, and in the tuberculous predisposition there is also, probably, a deficiency of earthy matter, yet the latter disease never produces that uniform softness which occurs in the former; there is in tuberculosis, also, an absence of that tendency to form regular curves, as of the spine and thigh bones, and of that peculiar distortion of the pelvis which characterises rickets; an absence also of the depression of the heads and necks of the thigh bones, of distortions of the joints from a yielding of their ligaments, and also of the progressive ascent of the deformity of the bones from the lower to the higher part of the skeleton, which ordinarily occur in rickets; the lower limbs first yielding to the superincumbent weight.* The peculiarities in the individual bones also differ widely; there is not that tendency to form exostosis in tuberculosis as in rachitis. Nor is the difference one of degree only. The modifications of the skeleton in tuberculosis, as compared with those which occur in rachitis, indicate that the development and nutrition are vitiated from a different cause, and that the tuberculous blastema must differ essentially from the blastema of rachitis. Although rachitis and tuberculosis sometimes occur together in the same individual, yet, according to Rokitansky and other modern observers, the two diseases are rarely associated, and that they are not the same disease appears to be corroborated by the fact, that tubercle is less frequently found in children who have died from rickets, than in those who have died from other diseases.

The defects of the osseous structure, and the irregularities of the skeleton, like the malnutrition of the cellular structures, properly so called, indicate some specific defect in the material from which the bones are produced, and some deviation from the ordinary course of cell-development. All the malformations, even the extremes, as of very tall and very short individuals, appear to admit of one general explanation; a low vitality of the cells, rendering them incapable of regulating their own growth and organization, owing to which an arrest or an exaggeration of development is produced, and the symmetrical formation of the organs prevented. In considering the origin of these irregularities the malnutrition of the vessels which supply the bones

* Stanley on the Bones.

and their tendency to elongate ought not to be lost sight of. The malnutrition and defective cell-growth are also manifestly in relation to the diminished vitality of the blood, the imperfection of its nutrient elements, and the small number and probably imperfect organization of its red corpuscles.

C.—THE MUSCULAR TISSUE.

The simple fibrous tissue in individuals predisposed to tuberculosis exhibits abundant evidence, as already shewn, of that malnutrition which might, *à priori*, be inferred from the diseased state of the blood, and in particular from the vitiated quality of the liquor sanguinis and the deficiency of its fibrinous principle. The compound fibrous structures do not appear to have been very particularly examined; still, in the most unequivocal instances, the malnutrition of the voluntary muscles is obvious. Frequently, although by their size, especially in infants, they appear to be well nourished, that appearance is deceptive. Sometimes they are manifestly defective in colour, soft, slender, imperfectly developed, and badly nourished; hence they are generally described as flabby, and owing to the defective nutrition of the areolar tissue which surrounds them they are flaccid. It should, however, be remarked, that the malnutrition of the fibrous tissue, as represented by the voluntary muscles, does not appear to be so inseparably connected with the tuberculous predisposition as the defective organization of the cellular tissue. For it sometimes happens that where the predisposition exists without actual disease, the modifications of many of the structures dependent upon defective cell-growth are highly marked, while the muscular development and power continue perfect, and it is not until actual disease supervenes that the nutrition of the muscles begins to suffer. I have known youths hereditarily predisposed to tuberculosis, with very strong marks of the consequent defects of cell-growth in other structures, who exhibited extraordinary muscular development and power. The bearing of this remark will appear when we have to regard tuberculosis as a disease.

In the summary of the structural peculiarities of the tuberculous constitution already given it cannot escape the attention of the pathologist, that, regarding the animal body as constructed mainly of cellular tissue and simple fibre, osseous structures, mus-

cular fibre, and medullary matter, the peculiarities in question affect most especially the three former. In truth, there are not wanting grounds for considering the malnutrition as essentially an affection of the fundamental cellular tissue, proceeding from the vitiated blood either of the parent or the individual. But the other structures are frequently involved, whether correlatively or secondarily to the cellular tissue. In a great majority of instances no evidence exists of structural change in the medullary matter, and we shall find reason to conclude, from the perfection of the animal functions of sensation and irritability, and from the state of the intellectual faculties, that in many cases, at least, the medullary matter remains intact; although in others, the derangements of the mental and nervous functions are such as to lead to the inference that structural modifications of the brain and nerves may sometimes occur, and, like the malnutrition of the other tissues, may be congenital.

D.—THE PECULIARITIES OF STRUCTURE IN INDIVIDUAL PARTS AND ORGANS AND PARTICULAR REGIONS OF THE BODY.

The morbid state of the blood and blastema, and the malnutrition of cells and fibres are not only exhibited in the various tissues, but some remarkable peculiarities are observed in the form and development and the general characteristics of individual parts made up of different tissues. It may be stated generally that in the tuberculous constitution all the laws of development are liable to be disturbed; the growth is frequently very slow and unsteady in its progress; proceeding for a time in the usual manner, then remaining stationary, perhaps for years, and again progressing with extraordinary rapidity; the latter circumstance frequently occurring towards the period of puberty. This unsteadiness of growth may depend upon changes in the constitution of the blood from causes which have not at present been observed. An analogous circumstance occurs when children are attacked with fever—during convalescence they frequently grow very rapidly, a complete change having been effected in the molecular action and constitution of the blood. A very general consequence of this is a defect of symmetry, with a tendency, according to Hufeland and others, to the disunion of various parts of the body at the median line. The median line is also frequently removed from

the centre, the lateral halves of the body being unequal; a conformation, it is remarked by Lugol, of the worst augury, as respects future disease. Many of the features of the face present highly characteristic appearances. In some of the most unequivocal cases the structure of the eyes exhibits several peculiarities: they are frequently large, with a bluish or azure tint of the sclerotic coat, even in adult age, resembling that presented in the earliest infancy, explained by some pathologists by the preponderance of the venous system, and countenancing the idea, already several times adverted to, of an arrest of development. This coat is sometimes pearl-white, which, according to Hufeland, betrays a tendency to the mesenteric variety of the disease; it is also frequently traversed by streaks of enlarged and injected blood-vessels. The eyes at other times, particularly in young children, are haggard and inexpressive, and the Meibomian glands are liable to be spuriously hypertrophied. The eyelids are sometimes thick or œdematous. The mouth is unsymmetrical,—small, or large, or too much arched; the upper or lower lip, or both lips, are liable to become tumid from a spurious hypertrophy, consisting of an infiltration of the mucous, cutaneous, and cellular tissues of which they are composed; and, as stated of the cellular tissue itself, and from a similar cause, this tumidity is subject to a rapid increase or decrease from slight variations of the general health, and is frequently more perceptible in the morning than during the remainder of the day. In the upper lip the swelling frequently extends to the columnæ nasi and lower part of the nostrils, and there is occasionally a chap in the middle of the lip. The nose is sometimes swollen, red, and shining, and the alæ nasi spread in a remarkable manner. The lobes of the ears are also sometimes affected with a tumidity similar in its nature to that of the lips.

These peculiarities, with the modified conditions of the dermoid, areolar, and muscular structures incidental to the tuberculous predisposition, according to their degrees and varieties, and the mode in which they are combined, give the countenance several well-marked aspects. There is the pale, pasty, full cheek, with large upper lip and wide-spread alæ nasi of early childhood; the unnaturally fair or white complexion, resembling blanched wax, (but never so much so as in some cases of cancer,) with large

and conspicuous veins, combined with the roseate hue already described; the full, dark eye, with dilated pupil, long eye-lashes, regular features, placid expression, but extremely delicate skin; or similar features, with equally fine skin, and a fair, florid complexion. There are combinations, sometimes of great beauty, sometimes the contrary, among the associations, which, with other peculiarities belonging to the tuberculous habit, strike the experienced medical observer, and frequently lead him at once to the inference, that the structures have been developed from a defective blastema, and that probably they continue to be nourished from vitiated blood endowed with a low degree of vitality. The peculiarities of tint in different parts of the body, as in the skin and capillaries, depend in part upon the tenuity and transparency of the vessels themselves, allowing the fluids, whether circulating or stagnant, to reflect the rays of light through them, and in part upon a change of tint of the parenchyma; the whole of the phenomena being ultimately referrible to the blood; which is not only, as we have seen, deficient in red corpuscles, but in which, the yellow and blue colouring principles* of the liquor sanguinis have probably undergone some unknown changes, either in quantity or quality, involving modifications of tint in the blastema of the different organic tissues.

In the tuberculous predisposition the lymphatic glands over the whole body, but most especially in the neck, are believed to be larger than usual, although no accurate observations have been made on this point. They are, unquestionably, very prone to become enlarged, and in that state are regarded as one of the most certain diagnostic signs of that important variety of tuberculosis which comes under the designation of scrofula. The same remark applies to the tonsils, which, without any apparent deviation from the usual state of health, are liable to become spuriously hypertrophied, sometimes to the extent of affecting the voice and respiration; and this occasionally forms one of the few congenital signs of the predisposition. Baumes refers the habitual enlargement of the glands to an increased quantity of the blastema or nutritive fluid of the cellular tissue of these organs, which fluid he

* Chevreul, Lassigne, Le Canu, Sanson, Denis; quoted in Lectures on the Blood. *Lancet*, 1839-40, vol. i., p. 313.

believes to be of an acescent quality. We shall give the grounds upon which the acid theory of tuberculous affections generally rested, but there are no direct experiments to prove this acidity in the glands. The abdomen, particularly in tuberculous infants and children, is frequently very much enlarged; a circumstance readily explained by the malformation of the chest already described, and by the weak organization of the intestinal tunics and of the abdominal parietes, giving rise to habitual over-distension from flatulence and other dyspeptic effects produced by slight causes, and in some cases this distension is increased by enlargement of the mesenteric glands, which are liable to changes analogous to those of the external glands.

As respects the viscera, great doubts hang over the real condition of their organization in the tuberculous predisposition. Pathologists have made numerous observations of the morbid appearances exhibited after death from the different varieties of the disease; but in almost all these cases some local affection has for a long time existed, and contributed to destroy the patient. These pathological appearances will have to be considered under the head of tuberculosis in a state of actual disease; but it is difficult, if not impossible, to draw any inference from them as to the state of the same organs, where only the predisposition to disease exists. No doubt the viscera participate in the general malnutrition of the elementary tissues of which they are composed, and the defective cell-growth constituting this malnutrition, with the deteriorated qualities of the blood which pervades the organs, occasion the functional derangements about to be described. This probably constitutes in most cases the whole of their pathology in the tuberculous predisposition: an inference supported by the fact that where tuberculous subjects have died of diseases other than local tubercular disease, no constant pathological appearances are recorded.

Some pathologists, as M. Parola, Professor Rostan, and others, believe that an hypertrophied condition of the liver constantly occurs, and takes its origin even from fœtal existence; but, however frequent hepatic affections may be, we certainly find, in this country, a great proportion of cases in which no such hypertrophy can have existed. On the other hand, where the stature of tuberculous subjects is tall, it has been observed that the breasts and the

testes, in the respective sexes, are smaller and more contracted, and, as we shall presently see, they frequently fail in the energy of their functions.

The condition of the heart also demands special consideration. It is very generally admitted that, in some tuberculous diseases at least, the heart is within its usual dimensions, and this would be consistent with the malnutrition of its cellular and fibrous structures corresponding with malnutrition of these tissues generally. According to Bigot, of Geneva, the lineal dimensions are, *cæteris paribus,* in every way less in phthisis than under ordinary circumstances. Louis observed in 112 cases, in which death was caused by phthisis, that the heart, in the majority, was small, and very frequently not more than one half or two-thirds its ordinary size. Sir James Clark states, that he regards a small heart as a strong "predisposing cause" of consumption; and Mr. F. A. Bulley, and I believe other writers in our own country, have insisted upon this point. This, it is necessary however to state, has been disputed by others. Andral appears to have found the heart larger than natural in a majority of phthisical subjects, and the late Dr. Clendinning arrived at a somewhat similar conclusion; he found that the heart weighed considerably more in phthisical subjects than in health, but in chronic diseases generally there was an increase of weight in the viscera; and the increase of weight in the heart in phthisis, relative to the increase in weight of the other viscera, was very small indeed. New observations are required as to the size, density, and general nutritive condition of the heart in tuberculosis, distinguishing as accurately as possible its state of nutrition in the earlier and later stages of the affection, in the general disease, and after local affections of the viscera, particularly of the lungs, have for a long time existed, and previous and subsequent to the supervention of hectic fever. I have been in the habit, for many years past, of examining the heart in fatal cases of phthisis, and to the sight and touch it has in a majority of cases appeared to me to be of small dimensions or defective substance. The physical signs derived from percussion of the chest have also, in the main, favoured this view. In the minor degrees of the tuberculous predisposition, in which the cellular structures mainly appear to have been imperfectly developed, leaving the fibrous structures comparatively intact, the

heart may not only be as large as natural, in relation to the organization of the individual, but even larger; still I consider that in the more decided cases the heart is small and its nutrition imperfect, and that this condition of the organ is in relation to the low vitality of cells, cytoblastema and blood; and from the large amount of muscular fibre, as compared with cellular structure, the malnutrition of this organ may be very unequal in different cases.

SECTION V.

FUNCTIONAL CHARACTERISTICS OF THE TUBERCULOUS PREDISPOSITION.

The low vitality and vitiation of the blood in the tuberculous predisposition, and the peculiarities of the general anatomical structures of the body, and of particular organs and parts, already described, are necessarily accompanied by deviations from the perfect physiological standard of the corporeal functions. The structural characteristics are, however, more constant and more permanent than those belonging to the functions, inasmuch as the malnutrition of the tissues and the organic changes which take place are not so readily repaired, if the blood be restored to its proper vitality. The functional disturbances, so far as they depend upon the morbid state of the blood, are immediately corrected when this fluid improves, and in proportion to the degree of its restoration to the standard of health. The structural imperfections are frequently permanent, lasting throughout life, as exemplified in the osseous system. Even functional imperfections, in so far as they depend upon defects of structure, may also be permanent; or they may admit of very gradual correction, in proportion to the improved nutrition of the structures in which they are seated.

A deficiency of vital power, corresponding with the low vitality of the blood, and the structural imperfections of the tissues and organs, is the most general expression by which the state of the functions of life in tuberculous subjects can be characterised; and this is measured by a greater or less degree of permanent constitutional debility. This debility is exhibited in the organic functions especially, and has already been exemplified by the weakness of cell-growth in the ultimate nutrition of the body.

A.—THE DIGESTIVE FUNCTIONS.

Defects in the processes of primary digestion, short of actual disease, are among the most constant peculiarities of the tuberculous predisposition, and all the circumstances attending these defects prove that they are in relation to the peculiar qualities of tuberculous blood, and the malnutrition of the digestive organs. The tongue is, for the most part, covered with a whitish coating, and the whole alimentary canal is prone to increased mucous discharges, corresponding with the laxity of structure in the cellular, mucous, capillary and muscular tissues, of which the parietes of the alimentary canal are constituted, and also with the low vitalised condition of the blood which pervades them. It might be presumed, that the secretions essential to the digestion of food are liable, in a corresponding degree, to a deterioration of quality; and this is, in fact, shown to be the case by the unnatural appearances which the evacuations frequently present. The appetite for food, in tuberculous subjects, is frequently very good, indicating that the sentient principle of the function is unimpaired. It is frequently even craving or voracious, and this appears to correspond with the demands made by the organic tissues upon the deteriorated blood. The blood loses more than it can afford of its nutrient elements; in its deteriorated state it becomes rapidly exhausted during the greater circulation; and the exhausted blood, in its passage through the sentient tissues of the stomach, produces an excessive and morbid excitement of the sensation of hunger. At the same time, the vitiated, diluted, or, in some respects, defective digestive secretions, being poured into the alimentary canal from the same morbid blood, or the nervous tissues being involved in the general deterioration, sometimes diminishes or totally destroys the natural appetite; hence, as remarked by Lugol, many tuberculous children are never hungry, and do not digest a sixth part of the food which a healthy child of the same age would consume. In either case, according to the observations of Dr. Todd, the food neither satisfies nor appears to nourish, and there is an empty or sinking sensation at the stomach, only temporarily relieved by eating, the patient feeling, after a meal, as if he had long fasted, and being again desirous of taking food. From the same peculiarities of the organization, both of

the solids and fluids of the stomach, nausea and vomiting are easily excited, and the evacuated substances are acid, acrid, or in a less advanced stage of digestion than, from the time they have been received into the stomach, they ought to be, and are frequently mixed with an undue proportion of mucus or with vitiated bile, and the digestion of the food is attended with acid eructations and flatulence.

In the intestinal canal the fæces are liable to become very light, or drab coloured, or greenish, and there is at one time a deficiency and at another time a redundancy of very pale yellow or of greenish bile, not only corresponding with the morbid state of the blood conveyed to the liver, but indicating irregularity, and very frequently torpor, in the action of this organ. The bowels are prone to be more slow in their action than natural, unless, from an accumulation of mucous secretion and the presence of undigested aliment, their coats become irritated. In this case the tongue becomes red at its point, or at its point and edges, and presents prominent, enlarged papillæ through its mucous coating; flatulence occurs, accumulations take place in the intestines, and, from the weak organization of their tunics, the bowels become distended, increasing the habitual prominence of the abdomen already described; or diarrhœa may occur with partial and temporary relief. The evacuations are also liable to become very fetid, not only from chemical changes in the partially digested food, but from defective animalization of the whole fæcal mass, indicating the deficiency or deteriorated qualities of the digestive secretions.

These derangements of the digestive functions are frequently slight in degree and habitual, so that they cannot be regarded as constituting a diseased condition of the individual. In the minor degrees they form an important feature in that state of the constitution short of actual disease, which I am now describing as the tuberculous predisposition. They are more frequently observed in children than in adults, and in hereditary than in acquired tuberculosis; and in adults they are more frequently observed in acquired tuberculosis where an unwholesome or defective diet has preceded the indisposition than when the individual has been well nourished.*

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* Fournet, lib. cit. p. 674.

B.—THE FUNCTIONS OF RESPIRATION AND CIRCULATION, AND THE ANIMAL HEAT.

Of the Respiration.—In individuals of the tuberculous habit the respiration is frequently defective. When closely questioned they admit that before the manifestation of any disease, local or general, they were "short breathed," and this imperfect respiration frequently exists from birth. It sometimes amounts to dyspnœa. Andral remarks, that he has known several members of a family in whom difficulty of breathing commenced from birth, all of whom in turns became phthisical. The lungs are among the principal organs having a cellular basis, and, no doubt, participate in the malnutrition of structures having cells for their basis; hence the lungs themselves are defective, and are in a corresponding degree endowed with a feeble power of expansion. It is a law of the animal economy that the containing parts are adapted with geometrical precision to their contents, and I have already described the contraction of the chest which marks this predisposition. Thus, from the deformity of the chest alone we might infer that the lungs are imperfectly developed, but we have the best assurance of this in the feebleness of the functions, and in the diminished proportion of the red corpuscles of the blood. The contraction of the chest and feebleness of respiration may also be taken as an evidence of a general feebleness of the action of the right side of the heart; the whole clearly marking a debility of the pulmonary circulation, which, in many of the congenital cases, is radically, constitutionally, and frequently hereditarily, limited in scope and weak in power.

The contraction of the chest and the defective structure and functions of the lungs have been properly regarded, as long as the tuberculous state of the blood exists, as a real predisposing cause of the development of tubercles in the lungs, but they have also been regarded, without any conclusive evidence, as the cause of the tuberculous cachexia—that is to say—of the disease of the blood. This subject will have to be considered in a future chapter; it is sufficient here to observe, that the malnutrition of the lungs and of the bony parietes of the chest is of the same nature as that which is liable to pervade any other part of the system, that tuberculosis pulmonalis is but one form of tubercular disease, and

that if we were to admit this principle of etiology, we must also, by a parity of reasoning, admit that where tuberculosis meningitis exists without any pectoral predisposition or disease, that the irregular formation of the skull and malnutrition of the membranes of the brain constitute the cause of the disease of the blood.

There is a stethoscopic sign which deserves consideration in this place—I mean the *wavy inspiration* so well described by Dr. Theophilus Thompson. This form of inspiration may exist for years without being complicated with any sign of local disease, and without any transition to serious disease. Ultimately, however, it is liable to become associated with signs of pulmonary deposit. In the tuberculous habit it is extremely persistent. Dr. Thompson, having devoted considerable attention to it, has not satisfied himself of its removal, unless superseded by some serious symptoms, in any instance. This physician remarks that its persistency points to some organic change which is not necessarily tubercular—probably an exudation about the walls of the minute bronchial tubes, and the interstices of the pulmonary substance calculated to impair the elasticity of the surrounding parts.*

According to this view the wavy inspiration is probably the result of the malnutrition of the cellular structure of the tissues in the lungs, and as such a stethoscopic sign of the tuberculous predisposition. Although, like a majority of the other signs, it is met with only occasionally, and may occur, but in a less persistent form, in other diseased conditions, as in bronchitis.

2. *Of the Circulation.*—Independently of any inference that might be drawn from the malnutrition and diminished size of the heart, this organ has, for the most part, in tuberculous subjects a feeble contractile power. The contractile power of the vessels being proportionate, *cæteris paribus,* to the physical strength of their coats, which partake of the general defects of cellular and fibrous nutrition, the action of the vessels generally is also weak, and their functions are proportionately imperfect. Hence the usual pulse of individuals predisposed to tuberculosis is weak. The low vitality of the blood, the debility of the heart, and the tenuity and distensibility of the vessels, occasion a languid circula-

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* *The Lancet*, Nov. 29, 1851, p. 502.

tion in the capillaries, with a constant tendency to coldness and lividity in the extremities, and to partial congestions. This condition of the circulation is frequently the predisposing cause of congestive and inflammatory diseases, and so influences their symptoms and progress as to give them their scrofulous or tuberculous character. The state of the circulation explains many of the most prominent circumstances in the history of tuberculous diseases. The pulse of infants has occasionally been observed to be slower than natural, with longer intervals, the stroke of the artery against the finger being remarkably soft; but, generally, the weakness of the pulse is marked by celerity, softness, and by the facility with which it is rendered more rapid by the action of stimulants.

3. *Of the Animal Heat.*—Individuals predisposed to tuberculosis have great difficulty in sustaining the usual degree of animal heat, and this constitutes an important and a very general peculiarity. This is doubtless in many instances partly attributable to the deficiency of fat under the surface of the body and over the abdomen and other parts, by which the provision of nature for the purpose of maintaining an equable temperature by investing the body with a bad conductor of heat is prevented, and the body cools more rapidly than it otherwise would. But this low power of producing heat is manifestly in relation to the low degree of the vitality of the blood, to the small proportion of the red corpuscles, to the feebleness of the respiratory functions, and to the languor of the circulation. Hence the frequent coldness and clamminess of the extremities, and the remarkable sensibility to the impressions both of heat and cold, which are complained of or may be observed in tuberculous subjects.

C.—THE SECRETIONS AND EXCRETIONS.

It has already been shown that the secretions poured into the alimentary canal and subservient to the various stages of digestion are very frequently disordered. As respects the bile, the intestinal mucus, and probably the gastric juice, we have frequently very clear evidence of this derangement; and of those secretions respecting which we have not obtained any evidence, it is scarcely probable that they can be healthy when derived from blood in any decided degree tuberculous, and separated from that blood by ill-

nourished structures. The secretions and excretions generally furnish unequivocal evidence of the morbid state of the blood.

1. *Of the Cutaneous Secretions.*—Corresponding with the malnutrition of the cutaneous tissues, the morbid blastema which pervades them, and the vitiated blood circulating through them, the cutaneous functions are rarely in a physiological state. The skin is readily irritated by the slightest cause; it is either harsh and dry, or it secretes from the diseased blood acid, fetid, or oily materials. The insensible transpiration is said to be very frequently defective, but the determination of this as a subject of experimental inquiry, has never been undertaken. Considering the large proportion of the ingesta which passes off by transpiration in the physiological state,—say nine-sixteenths—the question, —What is the state of the constitution in reference to this function in individuals predisposed to tuberculosis? is a very important one. This function should be examined in relation to the actual state of the blood, the respiration, and the nutrition of the cellular and adipose tissues, and of the body generally. Many tuberculous subjects are very little subject to general perspiration. Others have a great tendency to perspire on the least exertion or excitement. Almost all are especially prone to copious partial sweats; the palms of the hands, the soles of the feet, the arm-pits, the groins, and the fold behind the ears, being easily rendered damp, and the feet and hands clammy and cold; and these perspirations in the feet and arm-pits are often attended with a very fetid odour.

2. *Of the Adipose Secretions.*—The fat of scrofulous subjects is described by some of the old writers as whiter, firmer, and more disposed to collect in masses than usual.—(Baumes.) Tuberculous subjects are frequently moderately fat, particularly as children or while young. Occasionally they are very fat—Fournet found ten such subjects, the majority of whom were females, in 192 phthisical patients. This fat is said to be defective in composition, although we have no evidence of the fact; but experience confirms the observation, that it is very readily deposited and very readily absorbed. Recent discoveries also shew that the oily principle of nutrition is in some way very intimately connected with the speciality of the tuberculous habit. The tendency of the animal oil, at the temperature of the human body, to re-act by its elements, and pass into ulterior chemical compounds, as shown by the fre-

quent rancidity of the oily secretions from the sebaceous glands of the skin and scalp, appears to be in relation to the fetid tendency of the alimentary excretions and to the low vitality of the blood and of the mucous and cutaneous structures; the chemical changes being inefficiently controlled.

The secretion of oil, and its existence in the blastema, are probably essential to the nutrition of cells; but the new views which have been lately propounded on this subject, will come under consideration when treating of the general pathology of tuberculosis as a disease.

3. *Of the Mucous Secretions.*—There is a general predominance of mucous secretions in this constitution. These secretions are met with where in a perfectly physiological state of the mucous membranes nothing more than a fine halitus would be thrown off, and they are produced by slighter causes and sustained for more lengthened periods than in perfect health. This tendency to mucous secretion is in relation to the vitiated condition of the liquor sanguinis, and probably of its albumen, the aqueous state of the blood, the depraved blastema, and loose organization of the cells of the mucous membrane itself, already described. The tendency to mucous discharges from the alimentary canal has been mentioned. Such discharges are also frequent, and liable to be abundant, from the respiratory passages, the nose, the eyes, and ears, as also from the lining membranes of the urinary and genital organs, both male and female; and this tendency will be found to have a direct relation to the special pathology when tuberculosis as a disease is under consideration.

4. *The Urine.*—In relation to the small quantity of colouring matter in the blood, the urinary secretion is for the most part paler than natural; its specific gravity is low, and it accordingly contains a smaller proportion of solid ingredients, corresponding in this respect with the diminished number of molecular actions in the blood, and the diminished amount of the change of matter, as between blood and tissue, over the whole body. Thus the urine furnishes a small proportion of urea. Its quantity is generally represented as moderate; but it frequently deposits a whitish sediment of phosphates and lithates, and, owing to the weak organization of the mucous membranes, the tendency to mucous secretion, and the readiness with which cells are cast off, it is apt

to present a larger proportion of mucus than usual, and to exhibit a mucous deposit.

5. *The Cerumen* is liable to analogous changes, being frequently in excess, with a fetid tendency. An excessive secretion also frequently occurs from the *Meibomian glands.*

D.—THE ANIMAL FUNCTIONS, AND THE FUNCTIONS OF RELATION.

1. *Of the Muscular Powers.*—The debility of the *voluntary* muscular system is indicated by the diminished tone of the muscles corresponding with their malnutrition; by their inability to sustain exertion; by the rapidity with which power is exhausted, and by the length of time required for the renewal of power. As respects voluntary muscular power, measured by the force and velocity of motion and the time required for its renewal when exhausted, the inferiority of tuberculous subjects, as compared with those in health, is frequently very great. But, in some individuals, although the muscular power is manifestly below the standard of health, the mobility, owing to the integrity of the nervous system, is remarkable, and they exhibit great aptitude for exertions which they can ill-sustain. The debility of the muscular powers is also frequently marked in infants by a difficulty and delay in the power of walking and of speech, and in adults by a feebleness of the voice. The low degree of *involuntary* muscular power is exhibited in the diminished power of the heart, the feebleness and distensibility of the muscular coats of the intestines and bladder, and especially by the action of the iris. The habitually dilated pupil, which contributes to give a peculiar lustre to the eye, and is a very important characteristic of tuberculosis, and perhaps especially of the consumptive habit, depends upon the diminished power of the iris. It has been remarked, that it is a better measure of the tone of the muscular system than the touch; since want of exercise alone would relax, for instance, the arm of a delicate female as compared with that of a labourer; but the iris is employed alike by the poor and the rich. Whatever the physiological explanation of the action of the iris, the habitual dilatation of the pupil, as it often occurs in tuberculous subjects, is an important sign of the general constitutional debility.

The debility in young children produces a kind of apathy to

motion of all kinds; the child from disinclination to move, requires to be dragged along by the hand; the ligaments are relaxed and the joints weak; and, as he gets older, the head is allowed to fall forwards from a difficulty of sustaining its weight, the muscles of the spinal column with those of the rest of the body partaking of the general malnutrition, and, as before described, becoming flabby and weak.

2. *Of the Senses and Moral and Intellectual Faculties.*—Even in infancy and early childhood, the general expression of the countenance frequently indicates some marked peculiarity in the sensorial and intellectual qualifications of those predisposed to tuberculosis. Sometimes the expression appears to be in advance of the age of the individual. Sometimes it indicates great torpor or hebetude, at others amiability with want of energy. Or the physiognomy may appear to indicate an advance of the mental faculties over the age and bodily functions during infancy, and the contrary in after years. Sometimes, also, the expression of the features, together with other signs of the predisposition already described, point out a tendency to tubercular meningitis. As age advances the sensorial and mental faculties of individuals constituted from tuberculous blood exhibit great varieties, and frequently stand out in broad relief upon the basis of their enfeebled organization. The senses are sometimes acute, and even morbidly so; the perception is keen, the memory tenacious, and the imagination predominant, and there is frequently a premature development of the mental faculties generally, with great acuteness of mind; the affections and passions are also sometimes remarkably ardent, and the temper quick and irritable; these qualities are most common in individuals with fair hair, florid complexion, and delicate skin, wherein the organization of the nervous system seems to have maintained its integrity. In other instances the senses are obtuse, and the individuals listless, the intellectual and moral powers the very reverse of the former, late in their development, in reference to the age and circumstances of education of the individual, and characterized by hebetude throughout life; this, for the most part, occurs in those who have dark hair, swarthy skins, and swollen, pasty countenances, and whose habits are indolent. If cretinism be regarded as a tuberculous affection, it is exemplified in its extreme form in the cretins of the Alps; here, from very early life,

and most frequently hereditarily, the nervous system must have been involved in the general deterioration of the organization.

Thus it would appear that these functions exhibit two extreme opposites. For the purpose of reconciling this apparent inconsistency as respects the sensorial and mental as well as the physical powers of tuberculous subjects, we must consider some circumstances connected with the development and nutrition of the nerves. Although the nerves are developed from cells, the dependance of the medullary matter upon the proper material of cell-growth appears to cease at a very early period of embryotic existence, and the medullary portion of the nervous structures becomes a secondary deposit in the cell membrane. The materials constituting the proper substance of nerves, with all other materials employed in building up and sustaining the animal economy, are equally derived from the blood, but they differ *in toto* from the materials required for the nutrition and growth of cellular structures. The nervous tissue differs from other tissues in that it never can, like them, be formed at the expense of the cellular tissues. This being the case, it by no means follows that a special morbid condition of the blood, which furnishes a morbid blastema to the cellular, gelatinous, and fibrous tissues, should necessarily furnish morbid materials for the nutrition of the anatomical nervous system. In many of the most unequivocal cases of the tuberculous constitution the anatomical structure of the nervous system is perfectly intact, although in other instances this structure may be involved, and the importance of this fact will be seen when we have to regard the symptoms and the varieties of the local diseases which supervene on the tuberculous constitution.

3. *Of the Generative Functions.*—Much difference of opinion appears to have existed as to the state of the generative functions in tuberculous subjects. According to Lugol, and Lebert confirms this view by statistical investigations, as respects either sex, they are frequently delayed. Young men, the former author states, are often in this respect little more advanced at eighteen years of age, or later, than children of six or nine years old, and females are no less backward in their development, often presenting no signs of nubility at eighteen. The voice, in the male, at the period of puberty, frequently remains infantile. In females, menstruation is frequently delayed or established with dysmenorrhœa, perhaps

for two or three years, or even the whole of life, the discharge being either inefficient, or only of one or two days duration; or excessive, lasting six or seven days, and unaccompanied by the other signs of puberty. It is a just inference from this delay that the maturation of the ovaries and ovules is retarded. In a few cases the reverse appears to happen, and tuberculous subjects are remarkably erotic. Scrofulous girls have been known to menstruate at three years of age; and Hufeland and some others have found an irresistible propensity to venereal pleasures, and have found children addicted to masturbation at seven or eight years old. That this has a relation to the tuberculous constitution is by no means certain. The signs of generative power are mostly deceptive,—a very little indulgence becomes excess, and induces exhaustion, which is not easily restored. Whatever the state of the generative power, either in the male or the female, the very common result of the exercise of that power is, that the fecundating principle derived from the tuberculous blood of the former transmits the tuberculous taint to the ovum, and that the ovum developed and nourished from the tuberculous blood of the latter, itself becomes tuberculous; hence the disease becomes hereditary.

4. *Sleep.*—In the tuberculous predisposition, and in tuberculous subjects generally, in all its grades and varieties, *sleep*, both during comparative health and in disease, in children and in adults, fails to renovate the powers and functions of life. It frequently, even appears to occasion fatigue; the return of wakefulness being attended with a sensation of weariness,—a circumstance best accounted for by the state of the blood, the accumulation of vital power by the renovation of the blood during sleep, after the exhaustion of vital power during the exertions of the day, being rarely sufficient for the demands of the system and the muscular exertions of the individual.

Finally, the tuberculous disease of the blood, even in its slighter shades, may influence all the functions of life. This influence is exhibited, not only in development, growth, and nutrition, in the habit or constitution, in the exercise of the functions and faculties, but in the succession of the stages of life, the processes of dentition, and the phenomena of puberty. As remarked by Baumes, they all announce something heterogeneous which injures and perverts the order and habitual succession of the phenomena.

That something we have described as the diseased condition of the blood. Many of these functional perversions, in their more aggravated form, become the symptoms of the most cruel disease with which mankind is afflicted, and, as such, they will have to be more fully considered as we proceed.

SECTION VI.

GENERAL SUMMARY OF THE STATE OF THE CONSTITUTION IN THE TUBERCULOUS PREDISPOSITION.

The preceding sections contain a detail of those structural and functional peculiarities of the constitution of man which have been handed down by the ancients, adopted by the moderns, and are confirmed by my own observation and experience as generally characteristic of the tuberculous habit.

The facts show that, where the blood is of that peculiar character already described, and designated "tuberculous," there is a disturbance in the development and an irregularity in the form of different parts of the body, particularly of those which have cell-growth for their basis. The whole or even the majority of the peculiarities of structure and function are by no means present in every individual affected; sometimes a few only are to be observed, and there are none which may be said to be constant. Even the malformations of the osseous system are not so general as has sometimes been thought. Fournet found about one-third of his phthisical patients had a well-formed chest.* In one case, the dilated pupil and smooth and almost transparent skin are the only outward signs of the predisposition; in another, the malnutrition and irregular development of the osseous system have proceeded so far, that the case borders on rickets, and there is but little deviation from the normal condition of the other parts; in another case, the tumid abdomen is observable, and there are signs which indicate a predisposition to disease in this region; in another, the malformation of the chest is the peculiar characteristic. A particular group of these signs is designated by Hufeland as "*The Scrofulous Physiognomy;*"† another group is described

* Recherches Cliniques. Paris, 1839. Vol. ii., p. 405.

† Traité de la Maladie Scrophuleuse—Traduit par I. B. Bousquet, 1821, p. 86.

by other observers as the "*Consumptive Habit.*" In the present state of science, it is impossible to explain why a tumid upper lip in one instance, an elongated maxilla, or an enlarged and projecting os frontis in another, is developed from tuberculous blood. Pathology is only on a par with physiology in this respect, since it is impossible to explain the innumerable variations of form and proportion among healthy individuals; why the blastema derived from healthy blood developes great muscularity in one case, and obesity in another; or why one person has an acquiline and another a Roman nose. To comprehend the causes of these phenomena, presupposes, not only a knowledge of the composition and chemico-vital molecular actions and metamorphoses of the blood and blastema, but also of the laws of cell-growth and organization, including those laws which determine the formation, elongation, splitting,* transformation, the occurrence of secondary deposits, &c., of cells, in the construction of tissues and organs,—a knowledge far beyond that which we at present possess. The modifications of cell-growth and organic development are frequently, particularly in the slighter cases, progressive from birth to mature age, at which time the individual presents, more or less completely formed, the tuberculous frame and general constitution.

The speciality of the tuberculous constitution has been described, at one time, as an "arrest;" at another, as a "retardation;" and again, as a "retrogradation" of development; but either of these terms is manifestly inadequate to define the nature of the peculiarities. It is true that, in the early infancy of individuals whose blood is tuberculous, the general frame is sometimes large, but, at the same time, thin,—that it wants the firmness of health, —and, as growth increases, it is found that the structures are late in attaining perfection, and the body is not well-proportioned,—there is a want of symmetry,—or it sometimes assumes a remarkably slender form,—imperfect formations, which have been referred to by several writers as illustrating the principle of an arrest of development. It is true, also, as urged by Dr. Addison,† that a retrogradation of structure in the mucous, serous, and fibrous

* Carpenter's "Principles of General Physiology." Par. 159.

† "On Healthy and Diseased Structure; or, the True Principles of Treatment for the Cure of Disease, especially Consumption and Scrofula." 1849.

tissues is exhibited in the tuberculous constitution—that "fibrous recedes into mucous, or both into cellular tissue," and that the cell organisms themselves retrograde into their embryotic condition; but all the facts cannot be explained upon that principle alone. The abdomen being prominent, the head large, the liver also large, and the extremities small, certainly correspond with the state of the fœtus, in these respects, at the seventh month of uterine existence; but the multiform variations already described cannot be accounted for in a similar manner. There exist a depravation of nutrition and an aberration of development, beyond a mere interruption to the ordinary physiological processes. The blood being tuberculous no doubt gives rise to an arrest of development; but it is not in its origin and essence an arrest of the development of organs and structures in their aggregate, but an aberration of nutrition in some and frequently in several of their component parts; and, although the tissues and organs may in all respects be regularly and fully developed, a tuberculous state of the blood may produce malnutrition, without the absolute supervention of general or local disease, at any period subsequently. It has been correctly pointed out, that this speciality of the organization consists of a modification in the *detail* of the structure of parts, as well as of the proper forms of tissues and organs.

This constitution manifests itself in every degree. In some individuals it is so decided from birth, that, sooner or later, and sometimes at a very early period of life, tuberculosis, as a necessarily fatal disease, occurs spontaneously. In others it is so slight and delicate that it is difficult to define it in words,* and the continued action of those causes which are capable of producing a tuberculous condition of the blood is required to produce its pathological results. In those individuals in whom it is manifested in the slighter degree, the susceptibility of the whole system to rapid change from a healthy to a valetudinary appearance, and the converse, is sometimes very remarkable. When the blood is tuberculous, the florid complexion and the appearance of a full habit easily pass away under the influence of fatigue, privation and disease; and when these causes cease to operate, and their opposites are in play, the blood recovers its normal constitution, and health is rapidly restored. It is always a most suspicious

* Dr. Tyler Smith on Scrofula, 1844, p. 19.

circumstance when we witness a young person becoming cachectic in a particular locality, as in a large town or under particular habits of life, exhibiting a pallid face with the functions of life languid, but recovering, (on removal to the country or the sea-side,) in a very short time, a florid hue with health and spirits, and then again rapidly declining—sometimes visibly relapsing in a week or ten days on return to town. This indicates a want of stability in the composition of the blood. When such subjects reside in towns, and take little exercise, they frequently become plump and rounded, not from an increase of muscle, or a deposition of healthy fat, but from that low state of hypertrophy and super-infiltration of the areolar tissue, which has been already noticed, and is indicated by the roundness and plumpness very rapidly receding on the occasion of any slight indisposition, or unusual mental or bodily exertion.

The tuberculous condition of the fluids and solids, even in the degree indicated by the expression, "the tuberculous predisposition," becomes a real predisposing cause of numerous diseases. Of these a state of dyspepsia, beyond those slighter shades of functional disturbance already described as contributing to form the predisposition, is amongst the most remarkable. Dyspepsia is so constant an attendant, and presents such marked symptoms, that it has been called "strumous dyspepsia," and is considered, by Dr. Todd and others, as a more characteristic feature than any physiognomical portrait that has hitherto been drawn. In its slighter and more evanescent forms it may be characterized by acidity, flatulence, irregularity in the action of the bowels, spasms, colic or worms. It is said to be so constantly present, preceding and accompanying the symptoms of tuberculosis, whatever variety or form it takes, as to rank as the cause of the disease. It will be hereafter seen, that the defective hæmatosis cannot be attributed to dyspepsia alone as a cause, but all experience confirms the facts; and there can be no surprise that, the fluids essential to digestion in all its stages being secreted from blood constituted as that of tuberculous subjects is, with the defective organization of the mucous and muscular coats of the alimentary canal, should render the digestion habitually feeble, and that dyspepsia should prove an important link in that chain of morbid actions which too frequently leads to a fatal result.

Among the affections to which tuberculous subjects are predis-

posed, the symptoms and history of which are influenced and more or less obviously explained by the peculiar state of the blood, and by the structural and functional modifications which constitute one or more of the varieties of the tuberculous habit, may be enumerated: —Cold indolent abscesses in the loose cellular structure, especially of the limbs, their particular symptoms and history depending upon the imperfect organization of the cellular basis and the tuberculous qualities of the blood; catarrhal affections, particularly colds in the head, attributable to the malnutrition of the mucous membranes, their proneness to mucous discharges, their irritability, and their tendency to congestion, which render them liable to be long-continued and attended with copious secretion; also exemplified in the tendency to leucorrhœa in females, and to hæmorrhoids in either sex; diarrhœa, with large alvine discharges, resulting from slight causes of irritation; hæmorrhages, as epistaxis and effusions of blood from the trachea, bronchiæ, urethra, and alimentary canal, arising, either with or without rupture, from the tenuity of the vessels and the diminished vitality and plasticity of the blood. Chronic glandular affections, invading the cervical, axillary, inguinal, or mesenteric glands; the lymphatic glands having a great tendency to enlarge from slight irritations of the mucous membranes or the skin; chronic affections of the thyroid gland; chronic inflammatory affections of the eyes, eyelids and ears; frequently occurring hordeolæ; chronic lippitudo or blear-eyedness; chronic conjunctivitis and chronic hydrocephalus, &c. Also chronic congestions of the lining membrane of the internal fauces, with enlargement of the tonsils.

The defective organization of the skin explains its liability, from the slighest friction, to extending and troublesome eruptions; and a similarity of organization both in the mucous and cutaneous tissues explains the liability to a running at the nostrils, the fluid from the ill-conditioned blood assuming an acrid and corroding nature, excoriating the parts it comes in contact with and producing ulcers which become covered with yellow crusts, concealing languid and pale or livid granulations; the extremity of the nose and the upper lip swelling by the extension of the irritation. This state of things is often associated with one or two other well marked signs of tuberculosis, as glandular swellings, an elongated lower maxilla, or an augmented development of the hands in proportion to the trunk; the whole, accord-

ing to their combinations, constituting different varieties of the scrofulous physiognomy, and to be accounted for only by the tuberculous state of the blood. This condition of the skin also constitutes the predisposition to numerous more definite cutaneous eruptions, which will be described in a future chapter.

A tuberculous state of the blood operates also as a predisposing cause of inflammation of the serous membranes, with specific symptoms,—hence—inflammation of the synovial membranes of the joints,—the tuberculous meningitis, as described by Dr. Hennis Green,*—the tuberculous pericarditis, as described by Dr. George Burrows,†—and the tuberculous peritonitis, as described by Sir H. Marsh,‡—either of which may occur in the predisposed without the deposition of tubercle, as well as in tuberculosis in consequence of the deposition of tubercle; also of chronic osteitis, caries, and necrosis, resulting from the peculiar organization of bone,—chilblains, attributable to the languor of the circulation of the extremities, the state of the capillaries, and the specific qualities of the congested blood; finally,—in illustration of the real predispositions established by a tuberculous state of the blood,—where the morbid irritation has invaded the nervous substance or its cellular envelopes, the nervous structures become liable to chronic congestions, inflammations and effusions; and epilepsy, insanity, and other neuroses may be classed in the category of the affections to which tuberculous subjects are predisposed.

In a tuberculous state of the blood, the constitution is prone to feverish attacks from irregularities of diet, exposure to cold and moisture, and from other very slight causes. The above facts show that a general ulcerous diathesis prevails, from which it is evident that absorption very constantly predominates over the other nutritive processes, owing to the diminished vital power or momentum of vital force in the various tissues, and the poverty of the blood, which renders it more apt to receive than to part with the elements of nutrition. This ulcerous diathesis is frequently exemplified by ulcerations of the cornea and of the articular cartilages. There is a tendency to excessive and unhealthy or spurious suppuration, which tendency is in relation to the vitiated quality of the liquor sanguinis; and the low vitality of the solids

* Medico-Chirurgical Transactions, vol. xxv., p. 192.

† Medico-Chirurgical Transactions, 1847, p. 77.

‡ The Dublin Journal of Medical Science, March, 1843.

and fluids generally, is favourable to the development of intestinal worms and other parasites.

Tuberculosis, as a blood disease, has not only a train of local and general affections to which it constitutes a powerful predisposition, many of which affections are in a great measure peculiar to itself, but it has a remarkable influence in modifying the symptoms, progress, and termination of most of the diseases to which the human frame is liable, and the effects of most of the remedies employed for the relief of those diseases. Inflammation in a healthy state of the blood differs very materially from inflammation in a tuberculous state of the blood, and its characters are still further modified where the structures have been nourished and sustained by tuberculous blood. It has a chronic and asthenic tendency, easily understood when we consider the low vitality of the blood, the diminished heat-producing power, the small proportion of corpuscles, and the vitiated liquor sanguinis. In healthy inflammation, cytoblasts, or the germs of cells form or make their appearance very rapidly in the blastema or exudation. In the exudation of tuberculous blood they do not appear so quickly. The exudation is not so genuine a *liquor puris;* that is to say, the cytoblasts, if formed, or exuded, are not so readily formed into pus globules. The fluid effused during inflammation, when the blood is tuberculous, has, again, far less tendency to form new fibre. Whatever may be the mode in which fibre is produced, there can be little doubt that the vitiated blastema poured out by the degraded liquor sanguinis accounts for the fact; and this consequence of the morbid state of the blood frequently renders the products of inflammation inorganizable where they ought to be organizable; as well remarked by John Hunter, there is frequently in the scrofulous constitution no adhesive inflammation.* So, also, by considering the qualities of the blood in the tuberculous predisposition, it is easy to understand, that it is one thing to extract blood, even in diseases requiring depletion, from an individual in whose blood, in his ordinary state of health, the usual proportions of fibrine and red corpuscles exist, and another to perform the same operation where the blood is deficient in red corpuscles and fibrine, and vitiated in its albuminous principle. The modifications of the action of remedies are also exhibited very

* Works by Palmer, vol. i., p. 590.

frequently in the application of blisters, leeches, setons, and even venesection, the injuries from which are sometimes slow to heal, or liable to unhealthy suppuration, or followed by eruptions of pustules in the surrounding skin. The bleeding from leech-bites is apt to be excessive, and with difficulty restrained. Membranous inflammation is prone to run into purulent discharge, as from the ears, nose, eyes, and vagina. Ophthalmia, in whatever structure it be seated, differs greatly in tuberculous subjects from ophthalmia in healthy subjects. Again, fractures are slow to unite. A wound, or a stump after amputation, affords a modified secretion when the blood of the subject is tuberculous; stumps have been described as secreting distinct curdy matter at the second dressing. Fevers, particularly those of the eruptive order, fluxes, lues venerea, in fact, all diseases, are more or less influenced in their symptoms, progress and termination; and frequently, when in their essential nature mild and salutary, owing to the peculiar condition of the blood and tissues in the tuberculous constitution, these become obstinate and fatal.

Thus, the tuberculous predisposition acts as a predisposing cause of a long catalogue of affections, and very essentially modifies almost all other diseases. In this point of view its importance could not be overrated. But tuberculosis is an idiopathic disease, *sui generis*, and no principle in medicine is better established than that the different varieties of this, the most fatal of all diseases that afflict mankind, present themselves most frequently in individuals of the constitution here described. As remarked by Andral, both in the old and the young, the development of tubercle in various organs, and in several organs at once, most frequently occurs in those who present the characteristics of the predisposition; and the development of tubercles is most abundant and most general where, from this constitution being most distinctly marked, we have reason to regard the blood as in the highest degree tuberculous. It is this direct tendency to favour the development of tuberculosis and the deposition of tubercle that we have especially to investigate as we proceed.

From all that has preceded, the tuberculous predisposition is not a mere aptitude to be more easily affected by the causes of tuberculosis. Short of actual disease, it is an abnormal state of the constitution, both in its solid and fluid constituents, and in its vital power, of the same nature as tuberculosis. Where the pre-

disposition ends, and where tuberculosis as a disease begins, it is most difficult, if not impossible, to define. Here, as in many other instances, nature operates by transitions—frequently there is no clear line of demarcation. Nor does the predisposition necessarily pass into disease. Many have been deemed consumptive throughout life from having exhibited this constitution in a well-marked form, and have nevertheless attained longevity, and died from some other malady. It by no means follows from this circumstance, that their blood was never tuberculous, and that they were never subjects of the predisposition; but it shows that, under favourable circumstances, the predisposition may never pass into actual disease, and that the blood has either been in a tuberculous state in a slight degree only, or, if more intensely affected during the period of growth and development, that it has recovered the standard of health at a later period of life. Even the conformation of the osseous skeleton, as of the bones of the chest, for instance, will improve, if the constitution of the blood be improved,—a circumstance which has been occasionally observed to happen without obvious cause. Again, it is most important to state, that tuberculosis may attack not only individuals of this particular habit, but even the robust, with a complete physical development, well-formed chest, and great muscular power. It may occur in either of the temperaments—lymphatic, sanguine, choleric, nervous, or melancholic—although more frequent in the first than in either of the others, and least frequent in the last. Individuals of a decidedly sanguine temperament occasionally die of phthisis. Examples of this are, however, comparatively rare; they occur most frequently in middle life, and they indicate the spontaneous generation of the disease, in the individual, rather than the hereditary transmission. In these cases, the causes of tuberculosis have operated at a later period of life, when the tissues and organs were completely formed, and when no more than the ordinary slow progressive waste and nutrition were in play; the result being the deterioration of blood, the rapid formation of general tuberculosis, and a quick deposition of tubercle in one or more organs, but without those modifications of the organic structures generally which constitute the predisposition, and which take their origin most especially during development and growth.

CHAPTER II.

ON THE SIGNS AND SYMPTOMS OF TUBERCULOSIS.

The prominent characteristics of tuberculosis, when it presents itself as a disease, are, like those of the predisposition, both structural and functional. When the disease is progressive, or so long as it is slight, the signs and symptoms may consist only of an assemblage or grouping together of a certain number of those deviations from the healthy structure of parts, and of those aberrations of function which have been so fully described in the first chapter as constituting the tuberculous predisposition. When it is an acquired disease, or if it be superinduced in a habit originally predisposed, but which, for a longer or shorter period, has been replaced by healthy hæmatosis and perfect nutrition, its more decided symptoms may be observed in addition to many of the characteristics of its slighter shades, and of its more continued operation. Under any circumstances tuberculosis has its appropriate diagnostic signs and symptoms. They are for the most part present from the very earliest commencement of the disease, and, in fatal cases, they generally continue in a state of aggravation or progression, till its termination. Hitherto the practitioner has been too much accustomed, in all cases, to look for the signs of local disease as the earliest indications; regarding the presence of these as essential for the affirmation of the presence of the general disease; and after the detection of local disease, all the symptoms have been too exclusively referred to this as a cause. Hence, from first to last, the signs and symptoms of the local disease have been strangely commingled with those of the general disease; as, on a future occasion, we shall find the causes also have been. The existence of tuberculosis as a general disease has thus been overlooked or denied. In this work I think I shall show that, in many cases, it is the disease of the blood which destroys the patient, and that sometimes the local disease has comparatively little to do with the fatal event. In all cases, it is a malady of the blood, characterized by its appropriate signs and symptoms, to which the local disease

must be referred for the explanation of its speciality and its fatality; and the general disease of the blood may be recognised by its signs and symptoms, throughout the course of every variety of tuberculous affection.

Viewed as a disease of the blood, independent of any local affection of the lungs, or of other organs or structures, tuberculosis may present itself in individuals of the constitution already described, in those predisposed by various debilitating causes, or in the previously robust and healthy. On the one hand, the predisposition may pass imperceptibly, without any obvious existing cause, into a state of disease; or the disease may be superinduced in such a constitution by the continued or renewed operation of its causes; the more essential characters of the tuberculous habit becoming more distinctly marked than heretofore, and the condition of health, or comparative health, superseded by that of real and unequivocal disease. On the other hand, tuberculous blood may be produced in healthy individuals at any period of life, from the operation of the causes of tuberculosis; and, according as these causes are brought into play earlier or later in life, or in proportion to the stage of development of the various parts of the body, the constitutional signs already described, particularly those which mark the irregular development of the different organs, may or may not present themselves. The occurrence of the disease in the predisposed is more common than the acquirement of it by the robust and healthy, but, in the latter, the morbid blood soon produces malnutrition of the same nature as occurs in the former, in those tissues where the change of matter continues active, as in the cellular tissue, the skin, and the mucous and serous membranes. Under all circumstances, when tuberculosis as a disease sets in, the changes of structure and function already described become more general and more decided.

The morbid condition of the blood in tuberculosis consists, in an aggravated degree, of many of those deviations from a healthy state enumerated in the preceding chapter. The deficiency which exists in direct investigations as to the state of the blood in individuals enjoying comparative health, but of a tuberculous constitution, has been pointed out,—there is a similar cause of regret that it has not been properly examined in tuberculosis or the tuberculous cachexia of authors. The analyses contained in the

first chapter are all I have to rely upon to form an approximative solution of this fundamental question, inasmuch as other analyses extant, although sufficiently numerous, have almost all been made of the blood of tuberculous subjects, in whom extensive and aggravated disease of internal vital organs existed; and even in a great majority of those I have introduced, there were intercurrent and superinduced local affections. As, however, the structural and functional disturbances which constitute the predisposition are consistent with the peculiar character of tuberculous blood already described, so it will be found that the whole history of the confirmed disease is consistent with a similar but an aggravated morbid condition of the blood. When carefully considered, the signs and symptoms of tuberculosis, viewed apart from those of the local affections and other complications, which are liable to occur, leave no doubt that the deviations from the physiological standard of the blood from which proceeded the tuberculous predisposition, and the more decidedly diseased condition of the blood in tuberculosis, are originally the same, differing only as respects the period and the degree of the affection. Thus the analyses lead to the conclusion, that in tuberculosis:—

The solids in proportion to the aqueous part of the blood are still further decreased, and this dilution progressively augments as the disease becomes more confirmed.

The proportion of the red corpuscles, a diminution of which constitutes one of the most important characters in the consumptive habit, is still further diminished when the disease sets in, and the diminution progressively increases as it advances; so that, in extreme cases, from 147 parts in 1000 in the adult male, they frequently fall to 80 parts. The deficiency in this part of the blood is not so great as in some less fatal diseases; in chlorosis, for instance, Andral found the cypher of the red corpuscles 30, whereas, in one case only of tuberculosis, did he find it as low as 72; and in his analysis of cases of phthisis, in its various stages, the cyphers oscillated between 80 and 100. In tuberculosis the loss of the solid constituents of the blood is not frequently sufficient to be accompanied with the characteristic *bruit* in the carotids.

The albumen probably still further increases in proportion, and the physiological and pathological products of the liquor sanguinis

indicate a vitiated elaboration in an increased degree; the protein base and its compounds—albumen and fibrine—being in all probability more vitiated in quality.

The fatty matters.—As respects the proportion of fat in the blood it has already been stated, that in the predisposition this element is probably below its physiological standard; but in many of the analyses of incipient phthisis, an augmented proportion has been found, and this increased proportion of fat is said to coincide with rapid emaciation which will presently be described as one of the most constant symptoms of tuberculosis. It remains a problem whether an excess of fat in the blood bears in this case a relation to the rapid absorption of fat during the emaciation, since, in many instances, it has been found that in ænemic conditions fat is often accumulated in the blood, while it disappears from the sub-cutaneous areolar tissue.*

The fibrine.—Tuberculosis rarely existing in a marked form, or continuing any length of time, without some local disease, either arising from malnutrition, or of an inflammatory or purulent character, developing itself, the blood, as already stated, has rarely if ever been examined in its simply tuberculous state; and since most of the superinduced local affections occasion a relative increase of fibrine and a relative increase of vitality, the analyses extant most frequently exhibit a higher cypher for the fibrine than they would otherwise do, and sometimes a higher cypher than the physiological standard; and, from the same cause, the clot, which in uncomplicated tuberculosis is small, weak, and diffluent, in cases as they actually occur, although small, is found to be tolerably firm and frequently buffy.

In the present state of our knowledge we cannot determine anything definite respecting the *salts* and *extractives,* but, as here exemplified, without, in the present imperfect state of the investigation, attaching implicit credence to the results obtained as to the whole of the above qualities, the blood gives ample evidence of an aggravation of that defective vitality which has been laid down as its most general characteristic in this disease.

When the blood is actually diseased, and tuberculosis unequivocally established, many of the phenomena which characterize the

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* Lehmann—Physiological Chemistry, vol. i., p. 263

predisposition become true signs and symptoms; but the more important diagnostics are:—

(1.) Anæmia.
(2.) Atrophy.
  a. Attenuation of the mucous membranes.
  b. Attenuation of the blood vessels and hæmorrhage.
(3.) Direct debility.
  a. Of the secreting functions.
  b. Of the digestive functions.
  c. Of the circulation and the involuntary muscular functions.
  d. Of the respiratory functions.
  e. Of the function of voluntary motion.
  f. Of the nervous functions.
  g. Of the generative functions.
(4.) Diminution of the power of sustaining the animal temperature.
(5.) Febricula.

SECTION I.

OF THE ANÆMIA OF TUBERCULOSIS.

Whether tuberculosis be developed in a constitution originally predisposed, or in the robust and healthy, one of the earliest symptoms is a general anæmic condition, which supervenes on the disease of the blood.

If the case be only a transition from a well-marked predisposition to actual disease, this characteristic becomes, with greater or less rapidity, more decided than heretofore; the appearance presented by the skin generally, and the complexion in particular, being more distinctly marked. The cutaneous tissues become more decidedly faded or dingy, or permanently pallid, the countenance only being subject to transient flushes. This anæmia frequently exists for a long time before tuberculosis is recognised as a disease. The lips and gums, which hitherto may have maintained their roseate tint, gradually assume the anæmic character, and the sclerotic coat of the eye, from the modified circulation, acquires a distinct pearly hue; the mucous membranes become pale, and apparently bloodless; the serous membranes partake of the same morbid condition; the muscles are pale, and the anæmic

character is preserved throughout, even in the case of a solution of continuity as in the vicinity of ulcers.

The anæmia of tuberculosis differs from simple anæmia. The blood-vessels are not so empty. There is not necessarily that tendency to syncope on assuming an erect position, nor to palpitation, œdema or effusion. The tissues are dingy rather than waxy; and in this respect it contrasts with the anæmia of cancer. The colour of the face varies much according to the temperament of the individual. In those with dark skin and hair, in whom the muscles are firm, the pallidity has a very light leaden tint, and the flush which occurs during excitement is of a brownish red, replacing the leaden paleness; but this differs greatly from the violent hue of asphyxia and cyanosis. In more delicate subjects with very fine skin, light hair and soft flesh, the puffy visage is of a tallow white, relieved on excitation by red flushes. The general surface of the body and not the face alone should be examined to judge of this symptom. Many of the effects of true anæmia sometimes result from the anæmia of tuberculosis, but not necessarily so; and, when the subject of causation is before us, we shall find that some of those causes which are undoubtedly adequate to the production of anæmia, even to its fatal extreme, never yet produced a case of tuberculosis. The anæmia of tuberculosis also differs from that of chlorosis in the character of the blood, and its concomitants, as well as in the peculiar hue which the tissues present. The anæmic symptoms, so constantly observed in this disease, mainly depend upon the particular morbid condition of the blood which constitutes tuberculosis, and most especially upon the diminished proportion of the red corpuscles; although in part also, undoubtedly, upon a diminution of the whole mass of the blood.

SECTION II.

OF THE ATROPHY OF TUBERCULOSIS.

Notwithstanding Louis came to the conclusion that in one half only of the cases of phthisis observed by him atrophy existed among the earliest symptoms, and he does not regard it as a precursor of tubercular deposit, and that Fournet found tuberculous subjects frequently moderately fat, being apparently in a

state of perfect *embonpoint* before any disease sets in, and occasionally very fat,—10 such subjects, the majority of whom were women,* occurring in 192,—atrophy is one of the most general structural changes in tuberculosis. It is sometimes that which both patient and friends are the first to observe as indicative of a modification in the state of the constitution. Frequently, indeed, it occurs with very slight concomitant indications of deranged health, and, as remarked when treating of the predisposition, it may prove of temporary duration, the frame recovering a perceptible, although spurious *embonpoint,* on some salutary change. The character of the emaciation of tuberculosis requires to be well considered by the practitioner. It takes its rise from the morbid condition of the blood, and the defective organization and nutrition of cells, areolar tissue, and of all those structures of which cell-growth forms the basis. There is a consequent loss of correspondence between the powers of deposition and absorption.

The first inroads of this emaciation are indicated by a diminished density and tension of structure. A soft and consequent yielding condition for the most part accompanies the anæmia already described. This diminished density and tension in the tegumentary membranes render the limbs flabby, frequently the first circumstance observed in young children becoming tuberculous. In children, also, the emaciation proceeds rapidly, especially when they have previously exhibited that puffiness and spurious hypertrophy which characterize the predisposition; and it occasions a peculiar shrinking of the features ; the delineations of the muscles being more distinctly seen.

Whenever, in a tuberculous subject, or under circumstances calculated to induce tuberculosis, a wasting of the tissues sets in, and becomes either insidiously or rapidly progressive, it is a sign well calculated to excite the most serious alarm.

The atrophy of tuberculosis is so important in diagnosis, pathology and treatment, that the practitioner cannot be too vigilant in its detection whenever its existence is suspected either in those who are predisposed to the disease, or in individuals placed under circumstances in which a tuberculous state of the blood is likely to be produced; nor too careful in watching its progress. For these purposes, direct observations on the weight

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* Recherches Clinique, p. 407.

are absolutely necessary. No vague notions on this point will serve any useful purpose. Patients, and those of the lymphatic temperament especially, will frequently mistake the puffiness of the face and spurious hypertrophy of the areolar tissue, which frequently conceals the true state of the adipose and muscular systems, for a really good condition of the general habit. If we trust to their representations, on the one hand the atrophy may proceed until tubercular aggregation in some important organ occurs, before we are certain of its existence, and on the other hand we can never appreciate the results of treatment. Nor is the determination of the absolute weight of the patient important only for the purpose of detecting emaciation, and watching its progress, as an absolute sign of the disease, and as a measure of the gross effects produced in the fluids and organic tissues by the vitiated state of the blood. It is also essential for the purpose of assisting in the estimation of the value of other symptoms. We shall find, as we proceed, that the respiratory powers are modified in tuberculosis, and furnish symptoms of the disease; but the weight of the body exercises a direct influence over the respiratory function, and in this point of view, it is essential to study the weight of the patient, and to be aware of the import of the absolute and relative weight, and of the variations of weight to which the body is liable.

To determine the weight, and for the purpose of detecting the first inroads of tuberculous emaciation, and watching its progress, I have followed Dr. Hutchinson's recommendation, and adopted the use of the French scale, or weighing machine, as a correct instrument, and occupying little space.

To Dr. Hutchinson we are indebted for many valuable experiments on the subject, and I propose to avail myself extensively of his results.*

There are certain points connected with the weight of the body which it is essential to bear in mind in making observations on the weight of patients labouring under tuberculosis, and as they are eminently practical I make no apology for introducing them here. As a general rule the weight of the body increases with the height; but the absolute weight in relation to the height varies considerably, being, nevertheless, within the physiological

* Medico-Chirurgical Transactions, vol. xxix., p. 137.

range. The weight, therefore, requires to be estimated in relation to the height, so that, together with the weight the height of the individual should be taken and noted. As a standard of comparison, Dr. Hutchinson has constructed a table of the mean weight of a large number of males at the middle period of life, in relation to their height. We shall find that tuberculosis diminishes the function of respiration, and excess of weight also diminishes the function of respiration; so that, in estimating the respiratory function, as a sign of tuberculosis in corpulent individuals, the latter circumstance must be taken into account. The influence of excess of weight, however, over the respiratory function, is not felt until the excess goes beyond seven per cent. of the mean; therefore, to the mean which an individual ought to weigh, seven per cent. must be added, before we allow for the corpulency as influencing the respiration. Dr. Hutchinson's table, which follows, comprises this latter circumstance. I have employed this table with great advantage. It is constructed from observations made on

2650 *healthy Males at the middle period of life.*

Exact Stature.	Mean Weight.	Weight increased by 7 per cent.
ft. in.	st. lbs. lbs.	st. 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
5 „ 4	9 „ 13 139	10 „ 9 149
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

The usual or natural weight of an individual may differ from the above standard both in *excess* and *deficiency;* and, at all times, deficiency of weight tends to show deficient nutrition. In tuberculosis, the absolute weight, in reference to the mean standard for the individual, not presenting a very marked difference, is a fact, *per se,* of considerable practical value; but, we shall presently find, that it has a most important bearing upon the subject of the respiration in this disease. In the present place we are only insisting upon the necessity of detecting and watching loss of weight as an important diagnostic sign of tuberculosis.

When in tuberculous subjects—or in subjects placed under

circumstances calculated to produce tuberculosis—a wasting of the tissues sets in, and becomes either insidiously or rapidly and obviously progressive, independent of any local symptom or physical sign whatever, it is calculated to excite the most serious alarm. Dr. Hutchinson lays it down, that a *slow* and *gradual* loss of weight is more serious than a *quick* and *irregular* loss of weight, and my own experiments fully confirm this remark. A person may, from time to time, *lose* and *gain* weight; but he cannot do this slowly and gradually without exciting suspicion of the existence of some serious disease. In tuberculosis the loss of weight is at first almost imperceptible, and would with difficulty be detected even by weighing. Omitting to avail ourselves of this process, it may proceed even to a considerable extent without being perceived; and as it does not appear that Louis weighed his patients, this is probably the reason why he failed to recognise any degree of atrophy in so great a proportion. If the diseased condition of the blood continue, the atrophy insidiously and constantly advances; and in an individual predisposed to tuberculosis, if this progressive waste is unattended with any decided organic or functional affection of the viscera, it may, therefore, be *more* rather than *less* alarming. It indicates that the blood is becoming so decidedly tuberculous, as to cease to be capable of sustaining the healthy functions of life, and especially the functions of respiration and nutrition.

Such is the importance of loss of weight and the emaciation of tuberculosis. It is quite true that death may occur in certain forms and varieties of the disease long before this emaciation takes place to any great extent; as, for instance, in cases of "acute phthisis," "tubercular pericarditis," &c.; but, then, the death is produced by some intercurrent disease, as pneumonia, pleuritis, perforation, or hæmorrhage. I lately examined the body of a female who died of pneumonia, with tubercles in her lungs, and an inch depth of fat over the abdomen; still she had lost weight before the attack of pneumonia. When tuberculosis pursues its course uninterruptedly this emaciation is progressive, distinguishing it from the periodical loss of weight which some persons undergo, even in health.

Lehmann states, that in exceptional cases atrophy does not occur in tuberculosis, even when the lungs are diseased to a great extent, and in these cases the tuberculosis is generally accompanied with

the fatty liver;* but the statement is extremely questionable, inasmuch as we know not whether in these cases the antecedents of the signs of local disease were noted.

The atrophy of tuberculosis differs from the more simple atrophy arising from starvation, hemorrhage, and the like causes, and also from that which exists after fever and some other specific diseases. In atrophy, from these causes, hunger arises and is persistent; healthy secretions are poured into the alimentary canal, sanguification is perfected, and a direct relation subsisting between primary digestion and ultimate assimilation, the atrophied tissues appropriate to themselves nutritious molecules, the endosmose of the cells in the tissues exceeds the exosmose, and recovery takes place; but in the atrophy of tuberculosis the hunger which arises is frequently inconstant, the digestive secretions are imperfect, indigestion almost constantly prevails, the sanguification is tuberculous, the blastema is not of a nature to afford proper nutritious molecules, the exosmose of the cells exceeds the endosmose, and, like the red corpuscles of the blood, the cells continue to waste, and the atrophy proceeds.

It has been well remarked, that the atrophy of tuberculosis is not simply a defect of nutrition, in which the number of the molecules which compose the tissues is decreased, the tissue retaining its natural composition and organization, but, corresponding with the special morbid state of the blood, it is an alteration in kind. As of the anæmia already described, it is not produced by a deficiency of blood only—a very common cause of atrophy—nor by fever, nor by excessive evacuations, nor by any defect of primary digestion; for in many cases neither of these circumstances have existed. The appetite and digestion may continue good till within a few hours of death; and in cases where emaciation from other causes has proceeded to the most extreme degree, tuberculosis has not been produced; but the emaciation of tuberculosis is attributable to a specific vitiation of the blood producing a corresponding vitiation of the blastema and mal-organization and malnutrition of cells, the vital power of which being below the healthy standard, there is a consequent excess of the disintegrating over the integrating processes.

This atrophy is not quite universal. It is exhibited in the membranous more decidedly than in the parenchymatous structures.

* Physiol. Chem., vol. i., p. 251.

The areolar and adipose tissues are affected by it in the first place. The secretion of fat being vitiated in quality, this morbid fat is probably first absorbed from the subcutaneous adipose tissue, and the effect of this absorption is a remarkable collapse in the features, which often lose their rounded form. In the interior of the body the omentum appears to suffer very early, and most probably the fatty matter surrounding the voluntary muscles—also that in the orbits; but in the latter situation and about the base of the heart it never entirely disappears. The fat cells may sometimes be supplied with a serous fluid in the place of the fat (Kölliker).

Although there is a two-fold cause for the emaciation of the muscles, the defective nutrition of the fibrous tissues generally, a frequent characteristic of the predisposition, becoming more decided when actual disease sets in, and the diminished use of the voluntary muscles, resulting from the debility which will presently be described, the muscular atrophy is less easily and later observed than the defects of the more superficial structures, which have cellular tissue for their basis.

From the experiments of the late Dr. Clendenning,* it would appear that the viscera, for the most part, do not participate in this emaciation. It falls upon the organs of locomotion, probably the heart, the cellular and fibrous tunics of the vessels, and the alimentary canal; but the liver, kidneys, spleen, pancreas, and other organs, appear to maintain their density and bulk. According to Dr. Boyd's "Vital Statistics," the average sum of the weight of the entire viscera—the brain, heart, lungs, liver, spleen, stomach, pancreas, kidneys and appendages, and uterus—after death from tuberculosis pulmonalis, between 17 and 60 years of age, in males, was 39·26 ounces above the natural standard adopted by Dr. Clendenning, and in females about 27·05 ounces; but in these cases the average of the weight of the lungs in males was increased 25·71 ounces, and in females 14·48 ounces. The heart both in males and females was very slightly increased in weight, the liver 5·63 ounces in males and 7·32 ounces in females.† The experiments upon which these statements are advanced were, however, made upon individuals who died with local disease; and it may be here stated, that in the midst of the general waste, as tuberculosis with local disease of the lungs especially, advances, a large

* Medico-Chirurgical Transactions, vol. xxi., p. 33, 1837.

† The Edin. Med. and Sur. Journ., vol. lxi., p. 288.

deposition of fat frequently occurs in the liver and kidneys, and probably in other viscera. M. L. Parola has lately dwelt much upon enlargement of the liver, which he describes as nearly a constant occurrence even before the development of any local disease; certainly before any stethoscopic signs can be perceived. Attaching great importance to this viscus, he quotes Meckel on its enormous size during fœtal life, and believes it the generator of the blood. He quotes, also, Professor Rostan, who believes that if on examining the liver by palpation and percussion the organ is found to be small and not unusually developed, so constant is its hypertrophy in tuberculosis that he infers a negative as to the existence of the disease. We know not what allowance ought to be made for the deposition of fat, or whether it constituted a part of the bulk in the particular cases examined, so that we cannot at present assume that the viscera are altogether exceptions to the general atrophy of this disease. The abdomen, unless distended by air in the intestines, becomes wrinkled and flat.

As tuberculosis is met with in this country, particularly in the early stages, before any local affection developes itself, there is reason to believe that the medullary matter is frequently exempt from the defective nutrition, for the reason already stated; although, in the more inveterate forms, particularly where the disease has been hereditary through several generations, as in the cretins, and probably in some of those infantile cases which assume the cerebral form, the medullary structure is, in all probability, involved. Even in active tuberculosis, as in the predisposition, this exemption of the structure of the nerves from the general deterioration, frequently secures the healthy performance of the nervous functions for a great length of time. Notwithstanding the rapid wasting and, as it were, liquefaction of the body, the sensorial and intellectual faculties are not only duly performed, but even more acute than natural, and, except from loss of power, which we shall presently have to notice, the sensations and mental operations of the patient deviate but little from those of health, till within a few days, and sometimes within a few minutes of dissolution.

In those cases in which the defects of the bony skeleton have formed part of a predisposition, when this atrophy sets in the defects become more manifest than heretofore; the projection of the shoulders, for instance, is greatly increased after the muscles

become emaciated and the fat absorbed; this emaciation is frequently more observable over the parietes of the chest than elsewhere, especially in females, the osseous projections becoming more and more defined, and this sometimes occurs before the individual has complained of ill health, the face maintaining its healthy appearance; the contraction of the chest accordingly becomes more obvious. It is probable that the bones participate in the emaciation. Laennec remarked, that they lose nothing in length, but he frequently thought that their diameter was lessened. The medullary canal, in the long bones, is sometimes enlarged by internal absorption, the walls becoming as thin as paper, and in general they certainly lose in specific gravity. From the earliest period sometimes the hairs fall off, owing to atrophy of their bulbs; and the nails, if not previously incurvated, become so from malnutrition and atrophy of the matrix, and loss of substance in the fleshy parts of the fingers. If no efficient means be adopted to renovate the whole mass of deteriorated blood, the attenuation proceeds; the adipose and muscular tissues are rapidly absorbed; the nose becomes pointed; the eyes sink in the orbits, although they frequently "sparkle with a liquid lustre;" the temples become excavated; the jaws hollow; the integuments of the mouth are, as it were, stretched over the teeth, and the patient frequently exhibits a kind of ghastly smile; the skeleton projects more and more through the skin; the muscles of the arms become indistinct; there is no vestige of breast except the nipple; the ribs may not only be counted, but their terminations may be seen; neither their articulations at the vertebral column nor at the sternum are concealed; the intervals between them are hollow and curved; the joints of the legs, hips, and arms become prominent and devoid of flesh; and the spines of the vertebræ project from the wasting of the muscles on each side. The emaciation is also exemplified in a remarkable manner in the leanness of the fingers, the joints of which appear thickened, and, from the shrinking of the flesh, the whole finger resembles mere bones covered with transparent skin; the hypochondriæ are sunk and retracted; the epigastrium and flanks adhere, as it were, to the spine; and the whole frame appears to be wasted, except, perhaps, the lower extremities, which are œdematous towards the last,—a circumstance which may result from debility alone or from pressure on the iliac veins, owing to the absorption of the areolar tissue and fat

which surround them, or both circumstances. In fine, the individual before death attains that degree of atrophy which in all probability led to the disease in its various forms, being called CONSUMPTION. This emaciation, and the structural changes described, are directly associated with, and explain many of the functional derangements yet to be noticed.

The absolute loss of weight in tuberculosis has been variously estimated. Dr. Boyd found in 141 consumptive individuals compared with that of an equal number free from the disease, the loss of weight in relation to the height was more than one-third of the whole body. When tuberculosis pursues its course uninterruptedly, the loss before death is considerably more, but the subjects of it are most frequently cut off by visceral disease before it has attained its maximum. Hasse estimates the average loss at 48 lbs.

Atrophy is so frequently the earliest appreciable sign of disease in tuberculous subjects,—it proceeds so progressively and uniformly from the commencement to the termination,—it is so little related to the *extent* of local disease either in the lungs or elsewhere,—it is so directly related to the diseased condition of the blood,—that there can be no doubt it is, from the beginning to the end, symptomatic of the general disease. Local affections of the intestines—of the mesentery—of the lungs—or hectic fever, may precipitate it; but in instances where tuberculosis has pursued its course without a symptom of hectic fever, and where the vital organs have been comparatively little affected, emaciation has reached its utmost limits before the death of the patient.

A.—OF ATTENUATION OF THE MUCOUS MEMBRANES.

Owing to their comparative looseness of structure and greater delicacy of texture, these membranes are very liable to suffer at an early period from the malnutrition of tuberculosis. I have already described the characters they present in the predisposition, so far as they are known, which may be merely aggravated when disease sets in. An examination of the lining membrane of the mouth frequently affords very decided evidence of its anæmic and atrophied state, and from the condition of this membrane in various parts of its surface—the pharynx, fauces, epiglottis, lips, &c.—viewed in association with the general emaciation which prevails and the consequent symptoms, we may form an opinion of its atro-

phied condition throughout the alimentary and respiratory surfaces. It has to be remembered, however, that the tuberculous condition of this tissue renders it especially prone to those congestions which so readily result from the most trivial irritants, and hence this membrane is frequently red in patches and infiltrated, or spuriously hypertrophied in particular localities. The partially congested or irritated mucous membrane on the broader delicate anæmic and atrophied basis is sometimes very peculiar, and suggests an analogy to the circumscribed pink suffusion of the cheek upon the delicate pallidity of the surrounding parts.

The state of the organization of the mucous membranes and the condition of the blood which permeates them is well observed in the mucous membrane of the gums. M. Fredericq * has remarked, that in scrofula, the gums opposite the lower incisor teeth, and sometimes the upper also, are marked with a white streak, and in phthisis this is replaced by a red streak. This subject has been recently investigated by Dr. Theophilus Thompson. He describes as a very common appearance at the early period of phthisis—a delicate, pearly, transparent aspect of the border of the gums, "probably in part the result of fineness of structure." After the examination of numerous cases, Dr. Thompson also very frequently observed a mark at the reflected edge of the gums, usually duller in colour than the adjoining surface,—sometimes a mere streak, at others a margin more than a line in breadth, and in the most decided cases of a vermilion tint inclining to lake; frequently distinct around both the upper and under incisors, and sometimes extending around the molars, but narrower and fainter on proceeding backwards. Of 20 consumptive males this appearance was met with in 19; the exceptions in females were more numerous, and it appears earlier, or is more constant in hospital patients than in the comfortable classes under favourable circumstances of regimen. It occurs in the earliest stage of tubercular deposit in the lungs, but is more marked as the local disease advances, and is then sometimes attended with hypertrophy of the border of the gums, "suggesting an analogy to the tightened and deep-coloured skin around the border of the nails, attending even slight degrees of clubbing of the fingers." Of 33 men who had this sign, 23 had also the fingers more or less clubbed—hence the altered aspect of the

* The Lancet, Dec. 6th, 1851.

gums would seem to precede any obvious change in the fingers. When the line is most marked, and in advanced stages of local disease, patches of a similar colour are occasionally observed in the mucous membrane at a short distance from the lower incisors, sometimes also about the roof of the mouth and the inside of the cheeks, and this frequently coincides with diarrhœa.

I also have watched these appearances of the gums, so well described by Dr. Thompson, but I believe the red streak sometimes appears antecedent to the deposit of tubercle. Trifling as these appearances are, I believe them to be very significant. We see exemplified the atrophied and anæmic condition of the tissue, the morbid distensibility and tendency to congestion of the capillary blood vessels, the peculiarities of the tint of the morbid blood and the tendency to infiltration. I believe also with M. Fredericq and Dr. Thompson, that the red gingival margin generally coincides with local deposit in the lungs, or irritation in the alimentary canal. But this arises simply because the mucous membranes throughout their course are in a similar state of organization. I consider that the appearances are referrible to the disease of the blood, and not to the localization of tubercle as a cause. The existence of this sign in a high degree is, however, unfavourable as a prognostic sign, inasmuch as it indicates an aggravated degree of the blood disease, and the rapid progress of the local disease. Dr. Thompson has never seen it recede.

B.—OF ATTENUATION OF THE BLOOD VESSELS AND HÆMORRHAGE.

I have already enumerated amongst the signs of the tuberculous predisposition a tendency to hemorrhage, resulting from the attenuation of the blood and blood-vessels. When the consumption of the blood corpuscles and the attenuation of the blood-vessels has attained a certain stage, hæmorrhage very frequently occurs. It often takes place as an *accident,* without any previous sign of indisposition, in individuals of a tuberculous habit, or it may occur as an immediate consequence of the ordinary causes of local disease, as mental or physical shocks, or the impression of cold producing congestion and the like. However induced its importance depends upon its seat, and upon the actual state of the disease of the blood at the time it occurs.

It was stated in the first chapter that the mucous membranes of tuberculous subjects readily exude blood; bleeding from the nose

is a common occurrence, also from the intestines and urinary organs, more frequently than in the sound constitution. As a symptom of tuberculosis the most important seat of hæmorrhage is unquestionably the respiratory passages, where it lays the foundation for the development of tubercle.

Without attempting to cast a shadow of doubt on the admitted fact, that hæmoptysis is much the most frequently a consequence of tubercular aggregation, and as such symptomatic of phthisis rather than tuberculosis, I am satisfied that it is also not infrequently a symptom of the general disease, and the primary exciting cause of its localization. That, in fact, the ancient doctrine is true in many cases. To strengthen this view there is no occasion to refer to the individual opinions of the older writers, as we find it admitted by Laennec, Andral, Louis, and Fournet. Andral enumerates among the alterations which precede the development of tubercles, "an effusion of blood into the tissue of the lung."* It has occurred to me more than once to have the professional charge of young persons inheriting an unquestionable tuberculous constitution, in whom, without one physical sign of the existence of tubercles—not even the prolonged expiration in any part of the lung—hæmoptysis has suddenly set in, and been followed by the deposition of tubercles and all its consequences. Illustrative cases are recorded by Andral, where the effused blood became the nidus of the morbid deposit.†

In the post mortem examination of the subjects of tuberculosis pulmonalis it frequently happens that tubercles are found in different distinct stages of their development, each stage corresponding with the occurrence of hæmoptysis during life, and that the hæmoptysis was always attended with an aggravation of the symptoms. The patient had always pointed to these successive hemorrhages as the principal periods at which their disease had become aggravated; from which it may be inferred that the congestions or hemorrhages which occur during the development of the disease in the lungs have the effect of inducing new depositions of tubercle; and if this be admitted, there can be no doubt that hemorrhage in the first instance may be the cause of the deposit.‡

An illustration on a broader scale of the symptomatic character of pulmonary hæmorrhage as regards the general disease and its

* Patholog. Anatom., by Townsend and West, vol. ii., p. 553.

† Clinique Médicale, tom. ii., p. 39. ‡ Fournet, lib. cit., p. 465.

primary character as regards the local development, is furnished by Dr. Archibald Smith in his account of the diseases of Peru. Consumption is a very common disease on the coast, and there appears to be a general predisposition to hæmoptysis, which is its usual prelude. Dr. Smith remarks, that this predisposition consists in a general delicacy and relaxation of habit, with a contracted chest, and great delicacy of the respiratory organs, and particularly of the vascular system of these organs. Now, we are informed, that when this hæmoptysis comes on, the patient is almost sure to fall a victim to consumption by remaining on the coast; whereas, notwithstanding the hæmoptysis, they get well by going to the mountains. Dr. Smith thus illustrates this fact :*—

"Young women sent to the Sierra from the coast for spitting of blood, soon become round and plump; but they very often return to the coast too early, confiding to their quickly acquired strength, and then, should they become mothers, and offer to suckle their offspring, they pay the severe penalty of their indiscretion—for they are mostly sure to have a relapse, and are very frequently compelled to return again for safety to the mountains; or, should they be reluctant to leave home, which is almost always the case, they are in danger of deferring their journey from day to day, till it becomes too late, and thus they are precipitated into a fatal consumption,—characterized by purulent expectoration and hectic fever, &c." (p. 11).

The natives of the temperate recesses in the Sierra or mountains whose organization appears to be of a firmer texture and consistence, and whose vascular system may be supposed to be stronger, are mostly exempt from consumption until they have been resident for some time in Lima, when they lose their health, become tuberculous, and frequently die of consumption succeeding to hæmoptysis. This frequency of hæmoptysis on the coast of Peru would appear to be by no means analogous to the epidemic hæmoptysis, described by some of the writers of last century as occurring in similar latitudes, but never being followed by phthisis.†

Hæmoptysis occasionally follows over-exertion in running, straining, singing, coughing, or long speaking; and congestion within the chest is frequently produced by sudden mental emo-

* The Edinburgh Medical and Surgical Journal, vol. liv., p. 1.

† Observ. sur la Nature et le Traitement de la Phthisie, par Antoine Portal, Paris, 1809, p. 10.

tions, sudden suppression of the urinary, cutaneous or catamenial secretions, or suppurative or hæmorrhoidal discharges and eruptions; such congestion passing into hæmoptysis, both in the tuberculous and the non-tuberculous. In order to appreciate the operation of the exciting causes and diagnostic value of congestion and hæmorrhage the practitioner has to bear in mind the anatomical deficiencies in the formation of the chest, and in the structure of the lungs, and the probable weakness of the pulmonary capillaries in the tuberculous. Although hæmorrhage from such causes occasionally operates as a natural outlet and relief, or occurs as a vicarious discharge in the non-tuberculous, as far as my own experience goes congestion of the lungs rarely produces hæmorrhage in any quantity in other than tuberculous subjects.

Sir J. Clark has observed, that even where hæmoptysis as a symptom of tuberculosis comes on suddenly from any of the above-mentioned causes, or from some slighter or less obvious pulmonary exertion, the blood does not always appear during the exertion, but some hours afterwards. A young man, for instance, had made considerable exertion in ascending a hill; he returned home to dinner, and while dressing, was attacked with the hæmorrhage. Another, after delivering a lecture in the evening, which required considerable effort, had an attack during the night.* When hæmoptysis occurs as a symptom of tuberculosis, there being an absence of all signs of tubercles in the lungs, it is most important to ascertain the nature and extent of the exciting cause which has produced it.

An individual of a tuberculous constitution, but in his ordinary state of health being subjected from any cause to an accidental hæmoptysis, may recover from the attack; or, after such an attack, he may pass into a condition of general tuberculosis, and there may be deposit of tubercle at the site of the hæmorrhage, or in other parts of the lungs. This must depend upon the quantity of blood lost, the hygienic circumstances under which the patient is placed, and the medical treatment of the hæmoptysis. If these be favorable he may recover from the hæmoptysis, and have no symptom of tuberculosis for many years. I have witnessed such cases where death occurred years afterwards from other diseases. The hæmorrhage also sometimes recurs, leaving the patient in a more or less deli-

* Cyclop. Pract. Med., vol. iv., p, 291.

cate state of health, but without any sign of the aggregation of tubercles in the intervals. In such cases the deposition of tubercle is imminently impending, and unfortunately, in a great proportion of cases, before much lapse of time their existence is developed. In exceptional cases the converse is true. "I know a young man"—says the Italian translator of Portal—"feeble, delicate, with a mal-formed chest, who, for two years, and two or three times a-year, spat frothy blood abundantly without any apparent disease; he did not even become thin." Examples are referred to of a similar occurrence in individuals hereditarily predisposed to tuberculosis, both the parents having died phthisical. These effusions of blood are referred either to tuberculous congestions or pulmonary catarrh in tuberculous subjects.

At other times, although the hæmoptysis may have been the first circumstance to create alarm, it occurs as an early symptom of tuberculosis supervening on the tuberculous predisposition and is preceded by several other symptoms of general tuberculosis, and in particular by a degree of the feverishness and oppression at the chest which will be described as symptomatic of the disease. In these cases the danger of local disease is much increased. The blood effused into the pulmonary parenchyma acts as a foreign substance, irritates the adjacent tissue, and produces hyperæmia, inflammation, and consequently tuberculous deposits from the tuberculous blood; a slight effusion of blood is less likely than a large one to lead to a deposit of tubercle. Andral holds that the blood coagulates, becomes a living part, and secretes tubercle.* In either point of view the hæmoptysis is frequently the first symptom of the development of the local disease in the tuberculous habit.

Hæmoptysis is said to be very rare in children, and more especially, it has been seldom observed at the commencement of the disease.† But the difficulty which children have in expectorating and their habit of swallowing their sputa must not be lost sight of. With one exception of a child $3\frac{1}{2}$ years old Rilliett and Barthez never saw it in children under 7 years of age.‡ No anatomical reason has been assigned why hæmorrhage from exudation should not occur in children as frequently as in adults. In tuberculous

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* Lib. cit., p. 553. † Path. Anat. Transl., vol. ii., p. 553.

‡ Des Maladies des Enfans, p. 283.

children as compared with adults hæmorrhage is more frequent in other organs than in the lungs.

In a practical point of view nothing can be of greater importance than that, in a tuberculous constitution, hæmoptysis may occur without being preceded by any physical sign whatever of actual disease in the lungs. This hæmorrhage has been regarded in one point of view as salutary, relieving the congestion of the lungs, and in robust constitutions this is no doubt sometimes the case, but in tuberculous subjects the practitioner ought never to overlook its two-fold danger—on the one hand, the danger of the debility arising from the loss of blood, and the remedial measures necessary for its repression—on the other hand, the danger of the effused blood becoming an irritant or a nidus tending to the development of tubercle.

SECTION III.

OF DIRECT DEBILITY AS A SYMPTOM OF TUBERCULOSIS.

The debility of constitution characterizing the predisposition to tuberculosis, and exhibited in the weakness of the voluntary and involuntary muscular systems, the feebleness of respiration, the defective nutrition of the tissues, and the morbid irritability of the whole economy have been already described. So long as the peculiarities of constitution which have this debility for their basis are within the range of what has been termed "a predisposition to disease," the organic and animal functions—digestion, sanguification, secretion, excretion, the muscular, sensorial, generative, and intellectual functions and faculties—manifest a sufficient degree of order, regularity, and vigour, to constitute the ordinary state of health in the individual; but when tuberculosis sets in as a disease, this debility assumes a more definite form, and in several of its effects becomes a real diagnostic symptom. Observation accordingly shows that when, by the efflux of time, blood originally tuberculous, and also when, by the operation of the causes of tuberculosis, either tainted blood or blood totally exempt from a tuberculous taint, becomes so much deteriorated as to produce the malnutrition already described, the anæmia and atrophy are accompanied by this debility, and the debility of tuberculosis then becomes one of its most important symptoms.

The debility exhibited by tuberculous subjects is unquestionably

both *direct* and *indirect;* but I believe as a diagnostic symptom, it is the direct debility which most especially demands consideration. Like the anæmia and atrophy this direct debility is amongst the earliest and most constant symptoms. In by far the greater number of cases it commences insidiously and proceeds gradually, never ceasing till the disease itself is terminated. Even Bennet, the earliest English authority on consumption, saw the true bearing of this symptom:—"*That languor which slowly steals upon consumptive people without any decay of the lungs or other viscera, is to the English most dangerous; and unless remedies immediately take place (which they seldom do), is mortal.*" *

It generally proceeds in an equal ratio with the emaciation, but is sometimes manifest to the patient himself long before the wasting is detected. Sometimes it is barely appreciable, the patient only experiencing a little more fatigue than usual on ordinary exertions. Occasionally, after a continuance of longer or shorter duration, it appears to be and really is suspended; but this always follows the arrest of the progress of the emaciation, and is a real suspension of the disease; the subject of it, who had perhaps for a long time been losing health and strength, recovering both and resuming his usual habits or occupations, from a change in hæmatosis. This debility has several most important manifestations.

A.—DEBILITY OF THE SECRETING ORGANS.

In no part of pathology are there greater deficiencies than in that which relates to the state of many of the functions of life in the morbid condition which precedes the fatal outbreak of tubercular disease of the vital organs. As respects the organs subservient to the secretion of the digestive fluids, the gastric and pancreatic juices, we have no data beyond those to which I have alluded in the first chapter. The bile and the intestinal mucosities frequently give more decided evidences of mal-secretion as the disease advances. The latter are referred to under another head.

The Cutaneous Secretions.—We have no data to form any opinion of the state of the insensible transpiration. The skin is frequently dry and harsh, particularly where there is a tendency to external scrofulous affections. It is often, however, in that weak and relaxed state which subject it to occasional or frequent perspiration, par-

* "Tabidorum Theatrum, item Vestibulum Tabidorum." 1654—6.—*Eng. Tr.* 1720, pp. 158.

ticularly where the tendency is to internal tuberculosis. These perspirations are said to occur about the head, especially in children verging upon tubercular meningitis; and about the chest in individuals progressing towards tuberculosis pulmonalis; they are observed especially in the night or towards morning, the patient experiencing a degree of exhaustion and debility on rising. They are met with, unquestionably, without any evidence of local disease; and they are an indication of the increasing morbid condition of the blood, and of the structural and functional debility which its diseased condition entails.

The Urine.—We have no physiological standard of the urine as we have of the blood in the different temperaments with which we can compare it in tuberculosis, and we are left to infer almost everything from observation, and the few analyses extant of the urine in the slighter scrofulous and phthisical local affections. Becquerel and Rodier found in scrofulous diseases without fever, two kinds of urine. It was either anæmic, having a density of about 1010, with a tendency to become alkaline and decompose quickly, coinciding with much debility and exhaustion; or it was natural, with a mucous cloud occasionally present; uric acid in neither case depositing itself either spontaneously or with the addition of nitric acid.

The urine of tuberculous children is not simply anæmic, that is pale, of low specific gravity, and containing a diminished proportion of all its solid constituents equally; but it is sometimes of a faint greenish tint, and for the most part more acid than true anæmic urine. The free acid, has been represented as the phosphoric, (Fourcroy, Baumes, and Disse) the hydrochloric, the lactic, the oxalic and benzoic (Schönlein). It is like the anæmic blood, deficient in the proportion of its solid constituents and in the nitrogenized solids especially, but there is an excess of salts, and particularly of the phosphates. Disse found phosphoric acid in crystalline grains—lime is frequently found in the form of an oxalate. Where the nutrition of the osseous system is considerably involved, the comparative excess of the phosphatic salts is greater. Where the nutrition of the kidneys and bladder is especially involved, it is liable to become turbid and very speedily alkaline.*

When the disease of the blood is progressing rapidly with ema-

* Simon's Chemistry, vol. ii., p. 283.

ciation and impediment to the respiratory functions, it is highly probable that the relative proportions of uric acid and urea may be disturbed, the former being increased.*

The colouring matter is said to contain in tuberculosis pulmonalis more oxygen than natural, in the proportion of 33 to 27 per cent. Scherer believes that this colouring matter is in great part composed of the worn out and effete blood corpuscles. If this be correct there may be a relation between the state of the colouring matter of urine and the diminishing proportion of the blood corpuscles, but this enquiry is yet in its infancy.† How far these characters of the urine belong to the diseased state of the blood, and how far to local disease—to affections of the bones, skin, glands and other tissues—existing simultaneously, the present state of science does not enable us to determine. The whole subject is open to philosophical investigation.

My own observations on the state of the urine, during a period of many years, confirm the inference which may be drawn from the analyses, that in tuberculosis it corresponds with, and is to a certain degree the measure of the low vitality of the blood and tissues, the diminished molecular change of matter, the languid circulation, and the general debility; being anæmic, of low specific gravity, tending rapidly to alkalescence and putrescence, of low temperature, and, in proportion as the emaciation progresses, becoming, excepting as respects the proportion of water received and carried off, smaller in quantity, and containing a smaller proportion of solids, and particularly of urea and uric acid: but, in making observations on the urine the effects of the ingesta and especially of febrile action must always be allowed for in this diseased condition of the blood; as at all times, increase of density, colour, and acidity, with diminution of quantity, and the appearance of uric acid sediment, is the result of local disease, attended with fever; and the effect of the local disease on the urine, as of the local disease on the blood, has to be carefully discriminated from the morbid state of the urine symptomatic of the original disease of the blood.

B.—DEBILITY OF THE DIGESTIVE FUNCTION.

In a constitution already predisposed, and particularly in hereditary tuberculosis, those aberrations and defects of the processes

* Dr. T. Thompson and Mr. Rogers. "Lancet," Nov. 1, 1851, p. 408. † Idem, p. 408.

of digestion described as constituting so frequent and so prominent a characteristic of the predisposition become more severe. From a habitual inconvenience or peculiarity, they assume the form and intensity of active disease. These symptoms, which are of precisely the same nature, and indicative of the same pathological condition of the blood in disease as in the mere predisposition, viz.—malsecretion from tuberculous blood of the fluids essential to digestion—when grouped together, are generally described as "strumous dyspepsia."* They occur in one form in children when affected with tuberculosis tending to the development of scrofula, and in this sense the digestive organs may frequently be regarded as the primary seat of the local outbreak. The dyspeptic symptoms are sometimes present without the anæmia, emaciation, or muscular debility in any remarkable degree, and have, in consequence, been regarded as primary, and even as the cause of the disease of the blood; but the converse takes place, and the whole of these symptoms too frequently occur together to leave any doubt that they depend upon, and are diagnostic of one and the same disease. Even when most predominant, on careful examination there is always sufficient evidence from many of the structural and functional characteristics present, of the pre-existence of the disease of the blood. They are, as already detailed, extremely numerous and variable, but apt to be very differently combined in different cases. There is only one point of agreement for every group met with in practice, whether in the child or in the adult,—that they are all equally referrible to one cause, and rationally explained by that cause,—the special disease of the blood constituting tuberculosis. The morbid blood, and the anæmic and atrophied condition of the secreting tissues, furnish secretions inadequate for the due and complete performance of the digestive functions. Thus, in the autopsy of scrofulous subjects, Le Pelletier, Bordeau, and Garrod,† found the bile almost invariably less consistent and less charged with resin and colouring matter than in the ordinary state, and this was undoubtedly dependent upon the general disease, and not the particular form of it. This state of the bile, and the morbid characters of the mucous and gastric juices, as described in a former chapter, explain the character of the evacuations and the nature of the symptoms, and shew their dependence on the state

* Dr. Todd, Cycl. of Prac. Med., vol. ii., p. 654. † Lib. cit., p. 120.

of the blood, and that they are symptomatic of the general disease. The dyspeptic symptoms are, then, symptomatic of tuberculosis, since they are most frequently associated with the general anæmia, emaciation, and debility which characterize the general disease, and in the first place anticipate, and afterwards attend, the local complications, as glandular swellings, abscesses, diseases of the bones, the deposition of tubercle, and the like, although in some cases, from their long persistence, without any other local manifestation, they may be regarded as a distinct affection or variety grafted on the idiopathic blood affection.

When the habitual dyspepsia of the tuberculous predisposition becomes symptomatic of the blood disease, especially in children, the loss of appetite without sufficient cause, or the ravenous appetite, is so much aggravated as to excite attention. The habitual irregularity of the bowels and morbid condition of the alimentary secretions pass into diarrhœa, or are attended with colicky pains, so as to become the subject of medical treatment. The usual white film is replaced or complicated by the tongue becoming redder than natural, or its anterior portion is dotted with red spots, or with projecting papillæ, or covered with a mucous fur, through which the red spots appear, or the fur is distributed in small, circular, white patches, more or less confluent, presenting a dappled appearance; many of these appearances indicating that inflammation or irritation of the alimentary tunics has supervened. Sometimes the tongue becomes dry and of a brownish colour, indicating that the stomach especially is affected. Although these dyspeptic symptoms are rarely altogether absent where the blood is in a high degree tuberculous, and especially in children, yet they are liable to exacerbations from various and sometimes very trifling, causes, as irregularities of diet, the action of cold, the diseases incident to childhood, mental emotions, active passions, and the like.

In adults, although affections of the digestive organs are frequently less marked than in children, and more especially in those acute cases of the disease which arise without hereditary taint, they still occur. The prevailing characteristics are these :—The patient begins by complaining of slight pain and sense of weight and oppression at the epigastrium after eating, attended with a flush in the face, slight chilliness and feverishness. All the patient's illness is frequently referred to the stomach. These uneasy sensa-

tions do not prevent the appetite, but on the contrary this is frequently good and even voracious. Derangements, however, take place in the alvine evacuations analogous to those we have described as occurring in children. At first there is slight constipation alternating with natural and regular stools; then it becomes longer and more marked, is attended with colicky pains and followed by diarrhœa, which alternates with the constipation and regular evacuations. This affection of the digestion is especially observed among the poor and those who have been most exposed to the influence of bad nourishment;—least in those who are in the enjoyment of the comforts of life;—in some cases the affection never occurs—in others it is marked only by one or two symptoms, as sense of weight in the stomach or constipation.*

When tuberculosis is either acquired, or occurs more suddenly on a latent predisposition, these dyspeptic symptoms are also met with, as, for instance, in the cases which develope themselves after eruptive and other fevers, especially in children. But in the adult they are sometimes absent. The appetite often continues good; the usual quantity of food is taken; the tongue is little or not at all furred, notwithstanding the presence of the languor, debility, tendency to fatigue, and insidious emaciation already described. In these cases the organization of the stomach and alimentary canal appears to have been but little affected during the predisposition, and primary digestion is comparatively well performed, the appetite sometimes continuing till within a short period of the death of the patient from some local complication. In these cases the tuberculous blood appears to run into that stage which is attended with an immediate deposition of tubercle, without producing these functional disturbances in a marked degree. Commonly, in all cases where the tunics of the alimentary canal have suffered from the malnutrition, the digestive secretions are in a high degree depraved, and the appetite and digestion are bad. The secretions and excretions generally in tuberculosis correspond with the anæmia, emaciation, debility, and morbid condition of the digestion; and their unnatural condition is alike referrible to the diseased state of the blood. They are irregular and unequal, and frequently depraved, and for the most part, in the absence of fever, more aqueous than natural.

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* Fournet, lib. cit., p. 674.

C.—DEBILITY OF THE CIRCULATION AND OF THE INVOLUNTARY MUSCULAR POWERS.

In the involuntary muscular system, debility is also marked by an aggravated degree of those phenomena which have been described as observable in the predisposition, particularly by the dilated pupil and the debility of the muscular coat of the alimentary canal ancillary to the dyspeptic symptoms already described, but the general debility of the circulation is more especially characterized by the state of the pulse.

A Weak Pulse.—The state of the pulse has been regarded by some practitioners as the pathognomonic symptom of the tuberculous cachexia. Without regarding it as such in relation to tuberculosis, viewed as an idiopathic disease of the blood, inasmuch as very remarkable exceptions occur, it is still one of the most invariable and most important of the symptoms. Its great characteristics are weakness and frequency; but, in uncomplicated tuberculosis, the frequency is much less constant than the weakness. The frequency is particularly manifested towards evening, and readily excited by the most trivial causes, and it is most remarkably dependent upon mental impressions, and sometimes excited in the most extraordinary manner by moral causes. Although the pulse is very often *frequent* as well as weak, the frequency being aggravated by such causes, yet, according to my own repeated observation, where I have had no doubt of the existence of tuberculosis, without any local disease having yet manifested itself, the pulse has been weak and *slow*, but, at the same time, very easily hurried. The mere circumstance of laying the finger upon it to make an observation has been sufficient to quicken it, as happens in the case of patients essentially nervous without any disease of the blood. Under no circumstances has the tuberculous pulse either the strength or the hardness of inflammation, as exhibited in diseases of this class as they occur in subjects whose blood is healthy; neither has it the degree of weakness nor the smallness of low fever. It has been remarked, that this state of the pulse reveals more than the muscular debility or the emaciation, but I consider this as an exaggerated view of the value of the symptom, inasmuch as the exceptions met with in practice are more numerous. The pulse measures a peculiar state of the irritability of the living fibre, attended with loss of power, and depend-

ing upon the malnutrition already described, and the morbid condition of the blood. It points to a modification of the reciprocal molecular actions between blood and tissue, and a corresponding change in the resultant powers of life; the action of the heart being the most accurate measure of these powers. The frequency of the pulse by no means indicates increased velocity of circulation; for, although difficult to estimate, it is probable that the circulation gains less by the increased *number* of the heart's contractions, than it loses by their diminished *force*, and the state of the tissues generally indicates a languid circulation. In tuberculosis, there exists an unmistakable diminution of the vital powers; and this, as measured by the action of the heart and the state of the pulse, may be placed as a diagnostic sign, in reference to the general disease, upon a level with percussion and auscultation, in reference to that variety of it which is accompanied with local changes in the lungs.

D.—DEBILITY OF THE RESPIRATORY FUNCTION.

A SMALLNESS OF RESPIRATION, AND DIMINISHED VITAL CAPACITY OF THE LUNGS.

With the condition of the pulse already described, a small quick respiration may be constantly observed as symptomatic of tuberculosis, and demands the most accurate and most watchful attention of the practitioner. No doubt this symptom is more decidedly marked where there is a tendency to disease of the lungs, and where the nutrition of these organs is more especially involved. But, in the earlier stages, it is by no means necessarily dependent upon local tubercular disease of the organ. The breathing is, on the contrary, confined, frequently attended with a somewhat painful constriction of the chest, or the respirations are short and increased in number, liable to aggravation in the evening, without any further affection of the lungs than appertains to the general disease. It depends upon various causes,—the malformation and contraction of the chest, belonging to the predisposition,—the morbid nutrition and debility of the cellular and muscular systems generally, and the weakness of the respiratory muscles in particular,—the debility of the pulmonary circulation,—and the debility and irritability of the heart. The habitual or ordinary respiration corresponds with the excitability of the pulse in being easily hurried into dyspnœa, under the influence of comparatively trifling mental or physical exertion.

This symptom of tuberculosis has been studied too exclusively in connexion with disease of the lungs. I consider it of paramount importance in relation to the primary disease of the blood. The inspiratory and expiratory motions being accelerated but small, or small without being accelerated, indicates that the function of respiration, measured by the extent of these motions, is below the standard of health; the frequency of motion by no means compensating for the loss of extent. It shows a diminution of the *vital capacity* or *breathing power* of the lungs, which occurs, in tuberculosis, before any deposit or appreciable organic disease in these organs.

The feebleness of respiration, indicative of a diminished vital capacity, the practised observer will frequently detect with the unaided eye; but all observations of this kind must be vague and indefinite. The following plans have been proposed for the purpose of measuring more accurately the vital capacity of the lungs.

1. *The Common Tape Measure.*—One method is, to measure the mobility of the walls of the chest, since this corresponds very closely with the actual breathing power. This may be done with a common tape-measure. Firstly, the minimum circumference of the chest over the nipples, after a forced expiration; and secondly, the maximum circumference, after causing the chest to be fully expanded, should be noted. The difference is the mobility of the chest. In health this varies from $2\frac{3}{4}$ inches to 4 inches, and when reduced to less than 2 inches, according to Dr. Hutchinson's observations, it looks suspicious as respects the existence of local disease. A smaller diminution than this, but at the same time a very decided diminution of the mobility of the chest, corresponds with the debility of tuberculosis, independent of local deposit in the lungs. This method enables us to form a rough estimate of the vital capacity of the lungs, and I have found it practically useful; but there are numerous qualifying circumstances relating to the motions of the chest which ought to be taken into the account before any conclusion can be drawn from the results which it furnishes.

2. *Dr. Sibson's and Dr. Quain's Stethometers.*—Dr. Sibson has invented an instrument, for the purpose of determining more accurately the mobility of the chest; it is described in the "Medico-Chirurgical Transactions."* Dr. Quain's instrument is much

* Vol. xxxi, p. 354.

more simple than the former, and will be found described in the "London Journal of Medicine," October, 1850. Dr. Hutchinson, Dr. Sibson, MM. Beau and Maissaiat and M. Bourgery* have also made some very important observations on the mobility of the chest and the vital capacity of the lungs.† These observations involve considerations of paramount importance in the diagnosis and treatment of tuberculosis and its varieties. I propose, therefore to recapitulate some of the more important points.

In all cases of doubtful or incipient tuberculosis it is essential that the mobility of the chest should not only be observed on the earliest presentation of a patient, but that it should be carefully watched. When during ordinary respiration, it exhibits, either from habit or the position incidental to a particular occupation, a remarkable quiescence, and there is an inclination to maintain such postures as are favourable to that quiescence, the necessity of this vigilance becomes greater. On watching such patients, the diminution of respiration may sometimes be observed with the eye alone; but, for the purpose of determining it more accurately, I have adopted the use of the chest measurer.

Whatever plan may be resorted to, before we can appreciate the indications furnished in disease we must be aware of the degree and gradations of the chest's motion in health. The subject is by no means thoroughly understood, but many of the points determined by the physiologists quoted are of the greatest importance.

The mobility of the chest has three types: the superior thoracic, the inferior thoracic, and the abdominal. According to Dr. Sibson, the extent of the forward motion of the thoracic and intermediate ribs from the first to the seventh (superior thoracic), during an ordinary inspiration, in a healthy robust male, varies from 0·02 to 0·07 of an inch; the extent of the motion in a deep full inspiration varies from 0·05 or 0·07 to two inches. The extent of the motion of the diaphragmatic or lower ribs (the inferior costal or lateral expansion or type) is, in an ordinary inspiration, greater, and in a deep full inspiration usually less, than that of the forward motion of the upper part of the chest. The ordinary diaphragmatic movement (abdominal type) is from 0·25 to 0·3 of an inch; the extreme being from 0·6 to 1·6 of an inch. The expansion of

* Archives Générales, Dec. 1842, July and March, 1843.

† Idem, March, 1843, p. 375.

the second ribs is usually equal on both sides of the chest; but below these, all the inspiratory movements, especially those over the heart, are somewhat less on the left than on the right side, both during ordinary and extreme full inspiration.

These movements present numerous variations in health. In infants the thoracic expansion is proportionately increased, from being 0·02 to 0·12 of an inch, while the abdominal is from 0·06 to 0·15 of a inch; the lower end of the sternum and the adjoining ribs usually receding on inspiration, especially if the abdomen be large, and the inspiration quick and sobbing. In youth, owing to the greater flexibility of the costal cartilages, the extreme movement of the thoracic ribs is greater in proportion to the breathing capacity than it is in the adult, the upper end of the sternum advancing more than the lower during a deep inspiration, but there is little difference in ordinary inspiration; the motion of the sternum is also usually less than that of the ribs. In old age, owing to the consolidation of the cartilages, the motion of the sternum during inspiration is usually greater than that of the ribs, and the lower end of the sternum usually advances more than the upper end.

In females, the thoracic expansion is exaggerated, while that of the lower ribs and diaphragm is restrained. Dr. Sibson thinks this is owing, in great part, to the use of stays, the difference being much greater when the stays are on than when they are off. Messrs. Beau and Maissaiat recognize a more decided superior thoracic type of respiration in the female; but, with Dr. Hutchinson, these physiologists attribute little or no effect from the stays, since it is observable before stays have been worn.* When the stays are on, according to Dr. Sibson's measurements, the thoracic movements at the second ribs is from 0·06 to 0·2 of an inch, the restrained abdominal movement being from 0·06 to 0·11; when the stays are off the movements are 0·03 to 0·1 of an inch and 0·8 to 0·2 of an inch respectively. During a deep inspiration the restrained motion of the lower ribs is much greater when the stays are on than when they are off.

In observations on the mobility of the chest, Dr. Hutchinson remarks, that great caution is necessary to allow for a peculiar compensating power possessed by the respiratory function, which adapts itself for drawing in any quantity of air by modified move-

* Archives Générales, p. 397. Dec. 1842.

ments to answer certain changeable conditions of the economy relating to diet, digestion, sanguification, fasting, sleep, temperature, season, the purity of the atmosphere, &c. For the purpose of estimating the value of modifications of the mobility of the chest throughout tuberculous diseases, it is also necessary to bear in mind those which result necessarily from the anatomical peculiarities of the skeleton, described in a former chapter; as, for instance, the curvatures of the spine, and also the effects of diseases and injuries of the ribs and apparatus of motion, by which the motions of the chest may be permanently restrained or exaggerated; the effects of diseases of the abdominal organs in restraining the action of the diaphragm; also the effects of the various diseases of the chest which occur in tuberculosis, or independent of this disease.

Making allowance for all these circumstances, and apart from any local disease or pathological condition influencing the mobility of the chest, I believe, that in a tuberculous condition of the blood, the natural slight mobility of the upper part is for the most part materially diminished, and that the loss of mobility of the chest is in direct relation to a diminution of the breathing capacity. My opinion is formed more from observation with the eye and touch than from actual measurement with Dr. Sibson's instrument. Dr. Sibson states that he has not examined cases even of incipient phthisis; I find, however, that he gives cases where the mobility of the chest was small without thoracic disease, as in a pallid boy, aged ten years, with a diseased knee; attributing the diminution of respiration to loss of practice in the exercise of the ribs, I submit whether the loss of practice as well as the loss of mobility may not be symptomatic of a tuberculous state of the blood.

Dr. Sibson remarks that when the capacity of the lungs is diminished, the increase of motion on forced inspiration, compared with the motion in ordinary inspiration, is in a proportionate degree diminished. Thus, in a man who could inspire only 170 cubic inches of air, the ordinary mobility was only 0·03 to 0·07 of an inch, and the deepest inspiration only 0·5 of an inch; whereas, in a man who could inspire 290 cubic inches, the mean mobility of the ribs in tranquil breathing was 0·05, and in deep inspiration 2½ inches. When a loss of mobility of the chest on ordinary inspiration occurs as a symptom of tuberculosis, the expansion of

the chest during a forced inspiration is diminished in a proportionate degree. This symptom I have detected absolutely in several instances associated with other symptoms, rendering the case unequivocally tuberculous, but in which auscultation and percussion gave not the slightest indication of local disease.

3. *Dr. Hutchinson's Spirometer.*—We are indebted to Dr. Hutchinson for a still more direct method of measuring the vital capacity of the lungs in health and disease. This consists in determining the quantity of air expelled from the lungs by means of an instrument called a *spirometer*.

The largest quantity of air which an individual can breathe into and from his chest on a forced inspiration and expiration, is called by Dr. Hutchinson the vital capacity; and in this sense I use the expression throughout this work. The quantity is always the same for the individual in health, but differs in males, females, adults, and children, and is also modified by weight, age, height, and, as already remarked, by other circumstances.

Weight increases the vital capacity about one inch to the pound from 105lbs. to 155lbs., but above 155lbs. the weight of the individual prevents the increasing progression; that is to say, it diminishes the vital capacity from the mere circumstance of fat preventing the mobility of the thoracic parietes. Age does not affect the vital capacity so much as height. From 15 to 35 years it increases, and from 35 to 65 years it decreases, by age.

The vital capacity has a remarkably fixed relation to the height of the individual. For every inch of stature, from 5 feet to 6 feet, for instance, to the quantity of air which an individual is capable of receiving into and expelling from his chest after a forced expiration, followed by a forced inspiration at 60° Fah., eight cubic inches must be added. This may be called Hutchinson's law. No adequate explanation of it has at present been given. This vital capacity bears no relation to the size of the chest, either in depth or circumference, but is a measure of, and may be measured by, the mobility of the thoracic and abdominal parietes. An individual from 5 feet to 6 feet high, between 15 and 55 years of age, will inspire from 174 to 262 cubic inches, in an ascending scale, according to his height and age. The spirometer, by which this is measured, detects any disease which impedes the movements of the chest, so as to diminish the amount of air expired; and, according to numerous observations made by Dr. Hutchinson,

whenever the quantity is 16 *per cent.* deficient there is reason to suspect some local affection of the chest or abdomen. In the first stage of phthisis an average deficiency of 33 per cent. is observed in the vital capacity of the lungs, as measured by this standard; and, as the lungs become more completely diseased, their capacity may be reduced as much as 55 per cent.

The following is the table of comparison constructed by Dr. Hutchinson :—

Table of the Vital Capacity.

AT 60° FAH., FROM 4800 CASES.

Height.	In Health.			Suspicious Cases.	Phthisis Pulmonalis.		
	Age 15 to 55.	Age 55 to 65.	Age 65 to 75.	16 per cent. Deficient.	1st Stage 33 per cent.	2nd Stage 53 per cent.	Mixed 43 per cent.
ft. in. ft. in.							
5 „ 0 to 5 „ 1	174	163	161	146	117	82	99
5 „ 1 ... 5 „ 2	182	173	168	153	122	86	102
5 „ 2 ... 5 „ 3	190	181	175	160	127	89	108
5 „ 3 ... 5 „ 4	198	188	182	166	133	93	113
5 „ 4 ... 5 „ 5	206	196	190	173	138	97	117
5 „ 5 ... 5 „ 6	214	203	197	180	143	100	122
5 „ 6 ... 5 „ 7	222	211	204	187	149	104	127
5 „ 7 ... 5 „ 8	230	219	212	193	154	108	131
5 „ 8 ... 5 „ 9	238	226	219	200	159	112	136
5 „ 9 ... 5 „ 10	246	234	226	207	165	116	140
5 „ 10 ... 5 „ 11	254	242	234	213	170	119	145
5 „ 11 ... 6 „ 0	262	249	241	220	176	123	149

Thus, if a man be 5 ft. 8 in., and under 55 years of age, he should breathe out 230 cubic inches of air at the temperature of 60° Fah.; if 5 ft. 9 in., 8 cubic inches more, and so on.

The first column is gathered from observation, and is most to be depended upon; the two following columns are derived from calculation.

I have introduced Dr. Hutchinson's table because it is the standard to which I propose to refer in all the remarks I may make relating to the vital capacity. It will now be understood when I say that I admit a diminished vital capacity of the lungs as one of the diagnostic signs of tuberculosis. From the table we learn that there is a range of 16 per cent. below the physiological standard of the vital capacity of the lungs, as measured by the mobility of the chest and the quantity of air respired in a forced respiration, in which tubercles either do not exist, or their existence is doubtful. I believe that in many of these cases tubercles *do not exist;* and that there is a range of diminished breathing

power short of 16 per cent., and extending frequently beyond 16 per cent., which is a range of uncomplicated tuberculosis; and may be regarded as symptomatic of that debility and malnutrition which belong to a tuberculous condition of the blood. In illustration of this, as well as of several other points, I could not furnish a better example than that so often referred to by Dr. Hutchinson himself, which I here quote from this gentleman's profound and philosophical article lately published in the "Cyclopædia of Practical Anatomy."

"The effect of this disease upon the vital capacity in the case of Freeman was very remarkable. This man came from America, in 1842, 'trained for a *prize fight*.' He was examined when in his '*best condition*,' and his vital capacity measured 434 cubic inches (temp. 60°); height, 6 feet 11¾ inches; weight, 19 stone 5 lbs.; circumference of the chest, 47 inches; inspiratory power, 5·0 inches; expiratory power, 6·5 inches. Freeman fought his battle, and for the subsequent two years lived a rambling and dissolute life. In November, 1844, exactly two years afterwards, he came to town in ill health. At this time *there was no auscultatory evidence of phthisis pulmonalis;* but the *difference* indicated in the following table appeared in his *vital capacity-volume*."

	Vital Capacity.	Weight.		Inspiratory Power.	Expiratory Power.
	Cubic In.	st.	lbs.	Inches.	Inches.
November, 1842	434	19	5	5·0	6·5
Ditto, 1844	390	17	5	4·0	5·0
December, 1844	360	16	0	3·5	4·0
Ditto, ...	320	15	5	...	...

Dr. Hutchinson's investigations have been made almost exclusively on males; and although there can be no doubt that the vital capacity of females is less than that of males, we are not in possession of any accurate data by which to calculate the difference. M. Bourgery affirms, from observations made on seventy individuals, that the vital capacity of females is only half that of males.* I am certain, from my own observations on adults in this metropolis, that the difference is much less. Allowing for height, age, and weight, and omitting all questionable cases as respects the existence of disease, in a large number of females in my own circle of practice, the difference is certainly not more than 25 per cent.

The deficiences of the science of this highly important but intricate subject must be obvious to all. To render these observations

* "Archives Generales," 1843, tom, i., p. 375.

complete, we ought to be apprised of the amount of carbonic acid exhaled and oxygen consumed in tuberculosis. But few experiments have been recorded to determine this, although they would be more easily effected than after local disease has set in. Mr. Ure has favoured me with the following memorandum. "The only recent experiments with regard to the respiration in phthisical subjects are by Professor Scharling, of Copenhagen. They were made in the forenoon, and commonly repeated twice with each patient, the apparatus being thoroughly aired in the interval. Out of six phthisical patients, five expired less carbonic acid than healthy individuals of the same age and sex. The experiment with the sixth did not show any sensible diminution."* So far as it appears, these experiments are favourable to my general views as relates to the signs and symptoms of tuberculosis as a disease of the blood.

The diminished vital capacity of the lungs in uncomplicated tuberculosis bears, I am inclined to believe, a direct relation to the diminished number of blood corpuscles in the blood. This subject has not been adverted to by any pathologist, but the following considerations are important. The proportion of blood corpuscles in the blood of females, as compared with that of males, is, according to Le Canu,† 25 per cent. lower. Some other physiologists make the difference less. From my own observations, I conclude that the diminution of vital capacity in females, as compared with males, in health, is 25 per cent. or less. Hence, the difference of breathing power in the two sexes, in health, would appear to be in a direct ratio with the difference in the proportion of blood corpuscles in the two sexes. The same relation appears to exist in disease. In uncomplicated tuberculosis there is also a diminished proportion of urea in the urine, and we have seen that there is a diminished amount of metamorphosis in the tissues generally. Thus, we have a quadruple relation as respects—the portion of red corpuscles—the vital capacity—the nutrition of the tissues—the excretion of animal matter. This state of the animal economy has again to be regarded in reference to the pulse; for here we find a correspondence between the diminished number of red corpuscles, the defective vital capacity of the lungs, and the diminished power of the heart and weakness of pulse.

* "Annalen der Chemie und Pharmacie," 1846, p. 23.

† Etudes Chem. sur le Surg., p. 66.

The function of the lungs, so far as oxygenation is concerned; that is to say, the mutual action of blood and air in the blood brought into contact with the air in the lungs, appears to be completely performed in tuberculosis. Even in tuberculosis pulmonalis when a large proportion of the lungs have become impervious to air, as remarked by Dr. Young, the lungs do actually perform this part of their functions sufficiently well; since, when the patient is made to respire oxygen gas, the symptoms are not relieved by the greater supply of oxygen. But the reciprocal action between chyle and air, for the conversion of the former into blood, if it be admitted that this takes place in the lungs, must be the part of the function of these organs which is defective. Hence, healthy liquor sanguinis is not elaborated, the consequence being defective nutrition both of the corpuscles of the blood and of the solid structures of the system.

I may repeat, that I here throughout regard tuberculosis as antecedent to and apart from the organic diseases of the lungs, mesentery, brain, or other parts, which in the vast majority of cases ultimately supervene. But, as respects the chest, the relations above enumerated may have very important bearings. If a tuberculous state of the blood, with a progressively increasing diminution of corpuscles, is attended with a diminished breathing capacity, the indisputable principle laid down, that the parietes of the chest are adapted with geometrical precision to the bulk of its contents, would lead to the inference, that this diseased state of the blood promotes a gradual contraction of the chest. While—on the one hand—it may be shown, that the contraction of the chest tends to the aggravation of the blood disease, and more especially, perhaps, to the deposition of tubercles in the lungs—on the other hand—it would appear, as the disease of the blood advances, that its special condition co-operates with the debility of the moving apparatus in occasioning the chest to fall in, its motions to become contracted, and the shoulders to curve forwards—circumstances which have been so frequently observed in incipient phthisis.

In estimating the state of the respiratory function in tuberculous subjects, the effect of nervousness must not be lost sight of—a simply anæmic subject under nervous agitation may exhibit all the signs which occur in tuberculosis. The essential difference is, that in the one the symptoms are constant, and in the other, transitory.

In all cases, where any of the signs of tuberculosis exist, it should be the special object of the practitioner to detect early the smaller variations in the vital capacity of the chest; and as, after a diminution of this capacity and of the respiratory function which it measures, and before local disease has set in, it is not only possible, but comparatively easy to restore the function to its normal condition, the importance of attending to this precept will be readily understood.

B. COUGH.

A slight cough may exist in tuberculosis independent of bronchitis or tubercles, and may either be continuous—persisting until it becomes aggravated by local disease—or it may appear at intervals as the effect of temporary exciting causes, as too full a meal, breathing too warm an atmosphere, and the like. It is a very slight, dry, short cough, sometimes consisting of one or two hems, produced without effort, and sometimes without the consciousness of the patient; it may continue for a long period, and is more observable at some seasons than at others. It is sometimes attended with a very slight salivary or glairy expectoration, which passes into a mucous sputa, and is often associated with very slight bronchial catarrh; but when this passes off, the cough persists longer than it would in healthy constitutions. This kind of cough is by no means always symptomatic of the deposition and aggregation of tubercles in the lungs; it is always, when persistent, in a tuberculous condition of the blood, a very suspicious sign, but it may depend for a long time upon the morbid condition of the blood and the modified circulation and nutrition of the pulmonary parenchyma which precede the actual aggregation of tubercle, particularly where the malformation of the chest exists, with a general debility of its functions.

E.—DEBILITY IN THE VOLUNTARY MUSCLES.

In the Voluntary Muscular System there is a diminution of tone of the muscular fibres and a consequent defection in the power and actions of the various muscles, that is to say, in the organs or instruments of motion. It happens, by no means infrequently, that the first symptom complained of by a tuberculous patient is an inability to take the accustomed amount of exercise; or excessive fatigue on slight exertion; or, without any complaint being

made, the friends of the patient will observe an aversion to motion and a great inclination to sedentary habits. Muscular exertion frequently produces a slight cough, merely from debility of the respiratory system. The waste of the muscles is, in some measure, accounted for by this defection in the manifestation of power,—as a particular muscle wastes in consequence of the inactivity of a limb, so the general debility of the whole frame, by occasioning general inactivity, favours the waste of all the muscles of voluntary motion; but I shall have occasion to state that this inactivity is not the sole, nor, in fact, the primary cause of the debility and waste in question. This debility of the voluntary muscular system is also frequently indicated, particularly in young persons, by the position they habitually incline themselves to, which is one of flexion or relaxation, preferring the recumbent or sitting posture, and, when in the latter, presenting a peculiar bend of the spine and chest forwards, selecting such occupations as can be followed in that position,—as reading at a desk or table, frame-work knitting, &c., and continuing them for hours together almost involuntarily, or with an unconscious disinclination to assume the erect attidude or take walking exercise.

F.—DEBILITY IN THE NERVOUS SYSTEM.

The Nervous Functions.—In very numerous instances of tuberculosis, the functions of the nervous system are maintained and no impediment exists to the exercise of all the power or influence which is usually exerted through the nerves over the organic and animal functions. The debility which I have described in the functions of the voluntary muscles and other organs depends upon the inherent defects of the organ itself, and not necessarily upon the deficiency of any influence transmitted to it by the nerves. At the same time, the nervous powers become lessened in many cases, especially as the disease advances, although the malnutrition may not have reached their material organs; and in other cases, where these organs are involved in the general deterioration of structure, debility or total suspension of the nervous power results. Hence, nervous debility may be regarded as a symptom of tuberculosis.

The Moral and Intellectual Faculties.—The condition of the faculties in the tuberculous habit has been described in the first chapter, and the tendency to cheerfulness of mind and

hopefulness has been described. Dr. Mason Good makes a delusive hope of recovering a pathognomonic sign of tuberculosis pulmonalis. This state of mind is, however, by no means constant; it is most frequently observed in chronic cases of the hereditary disease, but not constant even here. When the disease is acquired from anti-hygienic causes, a very different state of the moral faculties is frequently observable, both before and after local disease sets in. This is characterized by agitation and inquietude; the unusual sensations produced by the morbid condition of the blood and the peculiarities of the organization are attended with a general sense of discomfort, a feeling of uncertainty and *ennui*—morosity—dissatisfaction—hysteria and hypochondriacism,—very disturbing both to patients and friends. "Patients, however, insensibly become accustomed to their new kind of life, and in some sort new physiological conditions occur; a gradual fusion takes place between their past and their new existence; the past is forgotten; their loss of flesh, their feebleness, their oppression, the morbid sensations they feel in the chest,—through habit have all assumed a natural colouring."—(Fournet.) In the most frequent form of the disease the hopefulness which succeeds is often continued to the last day and even to the last hour of existence.

G.—DEBILITY IN THE GENERATIVE FUNCTIONS.

The Generative Powers.—In treating of the predisposition, I have mentioned the discrepancy of opinion which exists as to the state of the generative powers in this disease. As respects scrofula, Lugol gives a very decided opinion, founded upon a vast experience, that they are below the physiological standard. He regards scrofula in either sex as a cause of the disease and death of the fœtus, and of its consequent abortion, and the debility of this disease as the cause of impotence and sterility. But we know well that, however enfeebled the offspring may be, children are readily enough conceived by parents, not only labouring under tuberculosis, but in some of its most aggravated forms, where local disease has manifested itself. There are no statistics, that I am aware of, on a sufficiently extended scale to determine whether they are more or less prolific than healthy individuals; particularly as there are none which embrace, not only the number of children born alive, but also the number of still-born children and

abortions. The fact that a large proportion of the cases of tuberculosis met with are clearly referrible to hereditary descent is a sufficient proof that in innumerable cases there is no absolute defection of the generative powers. Some authors believe that tuberculous subjects are especially erotic and prolific. There is a case recorded of the wife of a phthisical husband bearing five children at one birth.* It is a matter of experience that both tuberculous males and females frequently leave large families, and in my own practice I have known several large families where both parents were unequivocally tuberculous.

Dr. Walsh, founding his inferences upon 91 phthisical and 220 non-phthisical persons concludes that the procreative power of phthisical males is below the average—the fecundity of phthisical females considerably above it.†

Dr. A. Grisolle states it as an incontestable truth that pregnant tuberculous females (phthisical) have a greater tendency to abortion than those in health, although the tendency is not so great as generally supposed. In 22 females in whom aggravated tuberculosis may be presumed to have existed, inasmuch as tubercle was deposited after they became pregnant, three aborted from the fourth to the sixth month, three were prematurely delivered about the eighth month, and in the others the pregnancy pursued its ordinary course, although in two-thirds of these the tuberculosis proceeded through all its phases, producing "a profound cachexia.‡"

I am inclined to believe that in tuberculosis the sexual appetite and the generative powers are generally later in succumbing than in most other diseases—acute or chronic; at the same time impotence and sterility sometimes occur from local determinations, and have been particularly noticed by some writers.

Parturition—Is generally easy owing to the diminished size of the fœtus and the weakness of the structures both of mother and child, rendering them more yielding (Grisolle); but many exceptions to this occur owing to irregularities of the bones of the pelvis of the mother, inordinate development of the head of the fœtus, and other causes. Sometimes although the mother has attained a great degree of debility the infant is vigorous.

Lactation.—My own observation confirms M. Grisolle's state-

* Philosoph. Transac., vol. lxxvii.—1787, p. 344.

† A Practical Treatise on Diseases of the Lungs, p. 388.

‡ Archives Générales, Ser. iv., tom. 22, p. 41.

ment that females labouring under confirmed tuberculosis, unless the disease is so advanced that they die soon after delivery, have generally an abundant supply of milk at first, but after a few weeks or a month it fails: and lactation for ever so short a time sensibly aggravates the disease of the blood. Analogous phenomena to a less extent occur where only a predisposition exists, and in the slighter shades of disease. The milk from the tuberculous blood of the mother is serous and deficient in nutritive qualities, and seriously detrimental to the infant; it soon excites general tuberculosis and diarrhœa, and infants frequently die of softening of the mucous membrane of the alimentary canal without tubercles revealing themselves in any organ.

The Menstrual Discharge.—On questioning females as to their state of health before the occurrence of local symptoms, as well as from more direct evidence, it appears that for the most part the catamenia are diminished in quantity and paler than in health, and frequently very irregular, sometimes suddenly ceasing for several months and then partially recurring. After local symptoms set in as the general disease progresses, this state continues until the discharge entirely ceases. In Louis' cases it ceased at about the ninth month when the total duration of phthisis was under a year, and later when the disease continued longer. It may continue to the last. Throughout it is more likely to stop *suddenly* than in the amenorrhœa of chlorosis, and in this respect it is less in relation to the gradually diminishing proportion of the red corpuscles of the blood than the latter, and more in relation to a deeply-seated disease of the blood involving more completely the structures and functions of the animal economy. The sudden cessation of the catamenia frequently occurs very early in tuberculosis, and, like the dyspepsia in other instances, is often considered by the patient as her only disease.

SECTION IV.

DIMINUTION OF THE POWER OF SUSTAINING THE ANIMAL TEMPERATURE.

This, again, is one of the most constant symptoms of tuberculosis; and, if we regard the blood corpuscles, or the fibrine, or both, as the conveyers of oxygen from the lungs to the remote parts of the system, and oxygen as the supporter of vital heat, we

readily understand how, in tuberculous subjects, the proportion of the corpuscles in the blood being diminished, respiration limited, and the circulation languid, the absolute heat of the body is also diminished.

Believing, as I do, that the heat of animals is developed mainly in the blood itself, and physiology having clearly indicated that the red corpuscles are intimately concerned in the fixation of the oxygen from the atmosphere, so as to sustain the temperature of the blood at 98°, or thereabouts, we can readily understand that a diminution of corpuscles must be attended with a diminution of the power by which the result is produced, unless some compensating agency were brought into play. The only compensating circumstances we can conceive are, either an increased velocity of circulation, and more rapid and repeated change of matter in the blood,—which does not take place, since we have a languid circulation in tuberculosis,—or it might be compensated by a diminished expenditure of caloric.

The tuberculous are placed under similar circumstances of external temperature with the healthy,—they are subjected to the direct agency of cold, evaporation, the disintegration of tissues, and the like. Hence the blood, although sustaining the necessary degree of heat, by the resources of nature or by the applications of art, has a constant tendency to reduction of temperature; and the tuberculous are morbidly susceptible of the agency of cold. This is almost identical with the more general condition of a diminished vitality of the blood. It is a necessary consequence of the defective state of the blood, as respects its corpuscles, and the smallness of the respiratory functions. There exists a low power of producing heat. The effect of cold on the system is shown by objective as well as subjective symptoms—there is a great tendency to turn pale under its influence, with lividity of the lips and roots of the nails, and a disposition to coldness of the extremities of the nose, hands, and feet. Although this is a symptom of the general disease, and even of the habit or predisposition, and accompanies all the varieties of the local disease, it is most especially characteristic of those cases which tend to terminate in abdominal tuberculosis. As illustrating the diminished heat-producing power—not only while tuberculosis remains uncomplicated with local disease, but after local disease has set in—in very inflamed scrofulous tumours the temperature is not higher than that of the general system in its febrile condition;

and, when suppuration takes place, even this increase is not maintained. Becquerel and Breschet observed the temperature of a wound in a young man with scrofulous caries in the foot, which reached only 89° Fah.*

On the other hand the tuberculous are greatly inconvenienced by undue external warmth. This is particularly the case when, from having been extremely fat, owing to the progressing atrophy, the body loses its fat. Under such circumstances extreme external warmth is felt more than when the same individuals were in health. The high capacity for heat of the fat prevented the sudden effect of an elevated temperature in the blood and tissues. The muscular feebleness of the respiratory organs, and the constrained respiration, induce a degree of oppression. The instability of the balancing powers of heat and cold in the blood and vital structures renders the subjects of tuberculosis extremely susceptible of even slight changes of external temperature.

SECTION V.

FEBRICULA.

Although in the earlier stages, and in the more insidious forms of tuberculosis, fever is by no means a necessary or even a frequent concomitant, and the diseased blood may produce a gradual atrophy of the tissues, and proceed to a considerable extent without any febrile disturbance in the system, still, whenever a tuberculous state of the blood exists, fever is easily excited. Slight excitants derived from without or originating in the blood from a suppression of secretion or excretion, or absorbed from the tissues during the disintegrating processes, which, in a vigorous state of the blood, are rapidly eliminated or destroyed, will excite fever in the subjects of this disease of the blood. Independently of this, as an accidental or occasional occurrence, a continual slow fever is liable to set in as the malnutrition progresses. It is not the hectic fever, and, as remarked by several preceding writers, perhaps with little propriety called fever; but a state of irritation, exhibited by symptoms, sometimes for a long time before the accession of cough, scrofulous swelling, ulceration, or any signs of local disease.

This state consists at first of a general sense of uneasiness, languor, and feebleness, aggravated by the slightest exertion or

* Séance de l'Académie Royale, Aout 10, 1835.

irregularity of diet. There is a slightly increased temperature of the body generally, with a tendency to cold and a great susceptibility to the action of external cold; the skin frequently being warmer and acrid or arid, excepting at the extremities, which are colder than natural; there is slight thirst; a suppression of sensible perspiration, but after accessions of the feverishness and during sleep the skin becomes pale, soft, perspirable and cold to the observer. There is a great susceptibility to cold and tendency to slight rigor, this chilliness in connection with the feverish heat being a very constant symptom and of considerable importance in a diagnostic point of view. Many of the dyspeptic symptoms already described, especially irregularity of the bowels, attend this state; and it often happens that symptoms of this nature first call the attention of the patient to his state of health, who then finds to his surprise that he is losing flesh. The urine deposits a whitish sediment, and the breath is heated and fetid.

Patients differ much in the accounts they give of this state. In some it passes unobserved, and others refer it to some trivial circumstance of a temporary nature. The symptoms are subject to frequent slight exacerbations from very slight causes of excitement of daily occurrence. They sometimes observe an irregular periodicity, coming on after meals, or in the evening or morning, or both, and perspirations occurring after the febrile accessions, which increase the debility of the patient; these are, however, frequently partial, being limited to the face, neck, and chest. After a time the febricula becomes continued. There is an anxious expression of the countenance, but this becomes more manifest if local disease supervene.

This perpetual fever, no doubt, indicates the presence of something irritating the blood; it occurs most decidedly at the period when some of the special pathological results of tuberculosis, as hæmorrhage or the local deposit of tubercle, begin to manifest themselves; and, as there may be deposition of tubercle in particles, and a resorption of its analogue without any obvious aggregation, it certainly becomes a question whether this fever is not frequently the result of an animal compound absorbed into or produced in the blood before tubercle develops itself as a deposit so as to produce local effects. This febricula is in direct relation with the vitiated condition of the liquor sanguinis. It must not be confounded with that feverishness of digestion observed after

meals in many persons who have in no other respect the slightest indication of tuberculosis. When it occurs simultaneously with or supervenes on the anæmia, emaciation, and debility, we may be quite sure that the case is verging upon the deposition of tubercle.

The feverishness of tuberculosis is of more positive value as a diagnostic sign than either of the other symptoms—than the anæmia, the emaciation, or the debility. No subject of the disease has this symptom in a well-marked form with the chilliness I have mentioned without being at least on the verge of the deposit of tubercle. Since this feverishness also passes by almost imperceptible degrees into hectic fever, when it exists we must always entertain the suspicion of a deposit of tubercle. The existence or non-existence of the first stage of phthisis or mesenteric disease can be known only by the local signs; but I take the opportunity here of saying that with Fournet* I doubt the occurrence of such a case as latent phthisis—that is to say, the deposit of tubercles in the lungs with absolutely no symptoms. Where the signs of general tuberculosis exist there either are or are not tubercles in some organ. If these bodies be deposited in the lungs, local signs are added to the general symptoms, but the general symptoms, as far as I have described them, may occur without any local deposit whatever. I am fully convinced that the remains of tubercles have frequently been found in the lungs when their existence has never been suspected, but in these cases both the general and the local signs have been overlooked, and the disease of the blood has either been replaced by healthy hæmatosis, or the patient has died of some other malady.

It is not to be overlooked that scrofulous and other tuberculous affections frequently occur without the development of the signs and symptoms of this general disease of the blood. There may be only the very slightest manifestation of the predisposition. It is in this, in truth, that the innumerable cases of scrofula constantly occurring differ so widely from the majority of the cases of internal tuberculosis. These scrofulous affections occur when the blood is in that minor pathological state consistent with the condition of comparative health in the individual. In such cases, after recovery from the local disease, under favourable circumstances, the quality of the blood is often improved, and the individual is less likely to fall into a state of general tuberculosis and

* Lib. cit., p. 718.

to die of phthisis than if *(cæteris paribus)* the external disease had never occurred.

In some cases also the patient passes into the first stage of phthisis pulmonalis, tubercular meningitis, or mesenteric or peritoneal phthisis, having exhibited, but few, if any, of the symptoms I have described. This occurs in acute cases of acquired tuberculosis—for instance—where the deposit of tubercle in the lung commences from the very outset of the disease of the blood, and a state of health is very rapidly followed by hectic fever, and the combined symptoms of an acute disease of the blood, and an acute disease of the lungs. In some chronic cases of hereditary tuberculosis the progress is so insidious that tubercles are deposited before the individual makes any complaint. In reference to all such cases it must never be forgotten that many of the symptoms may pass for a long time unheeded by the patient, and such is the delicacy of their manifestation and the insidiousness of their progress that for a considerable period they may be overlooked by the practitioner.

SECTION VI.

GENERAL CONSIDERATIONS ON TURERCULOSIS AS AN IDIOPATHIC DISEASE OF THE BLOOD.

In this exposition of the signs and symptoms of tuberculosis, I think I have established that the anæmia, the emaciation, the debility, the symptoms furnished by the perversion of the natural functions of digestion, secretion and excretion, and the diminished power of sustaining the animal temperature, may all be referred to that morbid condition of the blood which I have exhibited in the first chapter in the form of a diagram, and especially to that diminished vitality which I have described as its most general expression.

The greater number of the symptoms enumerated are referrible to direct debility; but the malnutrition and consequent defect of organization in the organs by which vital power is more obviously manifested, although unquestionably productive of its effect, must not be regarded as the fundamental source of that debility. We are thrown back upon the question, What is the cause of this malnutrition? The debility as manifested in the symptoms is a defect of vital power, taking its origin in the blood itself, antece-

dent to the malnutrition of the more solid structures. The diminished and depraved nutrition of the tissues indicates that there is some defect in the proximate or ultimate elements of the blood, and that the metamorphoses of nutritive material are less in number; that the change of matter in the solids is less vigorous, and that there is a primary diminution and depravation of the molecular actions in the blood. The diminished amount of change of matter in the blood, and in the cellular and muscular tissues, must, from the nature of things, be attended with a diminution of the *momentum of vital force;* and this, again, explains the waste which takes place from the beginning, first, in the red corpuscles of the blood, and, secondly, in the muscles and other tissues; the corpuscles and tissues deteriorated, deprived of vital power, broken up, and absorbed, exceeding the organic material assimilated. The degree in which this loss of momentum exists is measured by the waste of matter and the muscular debility. But the cause of the progressive debility is the progressive decrease of vital molecular changes, first in the blood, and secondly in the solids. Thus, the debility of tuberculosis indicates a *direct* loss of power; and the whole of the phenomena of the predisposition and the symptoms of the disease show—

1. That from the earliest invasion the sum of the vital force is either below the standard of health, or it is relatively low as respects the structure and organization of the individual.

2. That this diminution in the sum of the vital force depends especially upon diminished vitality of the blood and of the cellular, gelatinous and muscular tissues produced and nourished from an imperfect blastema derived from the diseased blood.

3. That, as tuberculosis advances, the sum of the vital force for the whole system continues to diminish; this loss of vital force being exhibited not only in the defective manifestation of voluntary and involuntary muscular power, but in the diminished resistance of the vital powers of the blood and of the cellular and muscular tissues to the change of matter in the animal body; hence, in tuberculous subjects, the rapid diminution of the red corpuscles of the blood, the deterioration of the vital qualities of the liquor sanguinis and of the blastema, the diminished plastic power of the cells, the low calorific power and the emaciation.

4. That, frequently, but by no means universally, the nutritive powers of the blood, as respects the nervous tissue, remain

undiminished, this tissue not requiring for its nutrition compound principles identical with it to be introduced into the blood with the food, and having a nutrition peculiar to itself, differing from that of the cellular and muscular structures. Hence the diminution of vital force is not exhibited in the nervous system, but, as conductors of the force generated by the change of matter in the whole system, the nervous system remains intact. The particular condition of the vital force is, nevertheless, manifested through the nerves; hence activity and action without power, morbid irritability, &c. It is the highest manifestations of the vital force dependent upon nervous structure, as sensibility and mental phenomena, which so frequently remain unaffected during the physical degeneration. These phenomena are often rather augmented than diminished, the nervous matter although perfect in structure, being more exposed from the waste of its cellular coverings; hence, frequently, increased sensibility to impressions in tuberculous subjects; and this occurring in the predisposed from the earliest age, and throughout a series of years, an acuteness of intellect is often exhibited.

In estimating the symptoms of tuberculosis in a practical point of view, their absolute value, taken singly, is comparatively little, since one and all occur in other diseases. It is their relative value —the association of several—or the harmony of many in one case; the manner in which they arise—and their mode of succession—which distinguishes them from the symptoms of other diseases and assists us in the differential diagnosis. Many of these symptoms are found associated in chlorosis, simple anæmic debility from venereal excesses, and other conditions of the economy. To those who have well considered the details of the tuberculous constitution the difficulty of the diagnosis is considerably diminished. The symptoms viewed in combination and relatively rarely mislead, especially when they are decided in their development, constant, and progressive. In difficult cases our judgment may frequently be determined by a knowledge of the antecedent existence or the absence of the predisposing and inducing causes—as, for instance, of the hereditary taint, or a long-continued antihygienic regimen. In reference to the general disease it has to be kept steadily in mind, that the diagnostic object is not to determine whether a local tuberculous development exists—a tuberculosis pulmonalis or abdominalis—but rather to determine *whether the*

patient is truly affected with the blood disease, and thereby threatened with its local manifestation. The successful treatment of the disease of the blood in this stage, based on a knowledge of its nature and causes, is, in many instances, certain. The successful treatment of the disease after it has localized itself is frequently impossible.

While I refer all the symptoms described to the tuberculous state of the blood on the one hand, there is frequently, as they present themselves in various groups, a direct relation subsisting between them and the pathological effects of tuberculosis to be described in another chapter. The defects of the osseous system arising from perverted organization and nutrition of the bones, are in direct relation to the scrofulous affections of the bones which so frequently occur. The malnutrition of the lungs and thoracic parietes are in direct relation to the occurrence of disease of the lungs. The weak organization and depraved digestive fluids of the alimentary canal, taken with bad diet and other anti-hygienic influences, are in direct relation to mesenteric phthisis. Again, as illustrating the relation of cause and effect in the ultimate result, where the subjects of tuberculosis are fed with unwholesome and insufficient diet, they present after death, more frequently than other tuberculous subjects, pathological lesions of the alimentary canal. Fournet states, that tuberculous subjects who had been fed on a sufficient and wholesome diet, scarcely ever experienced disturbances of digestion until towards the close of life, and after death, he did not find a trace of intestinal tuberculization; while in those who, on the contrary, had been badly nourished for a long time, the dyspeptic symptoms were very prominent, and intestinal tuberculization was almost constant. I believe this statement to be somewhat too exclusive. But at the same time the complicated relations subsisting between—1, the effects of the blood disease and the local disease; 2, the effect of external agencies on the animal economy modified by the blood disease, are undoubted; and when we consider them it only enhances the necessity which exists of our improving the pathology of the general disease.

The uniform association of structural and functional aberration in the tuberculous constitution is very striking. The remark made by Louis that "a function may be more or less seriously interrupted for a long time without the organ presenting any

appreciable change of texture," is undoubtedly true—but we must not overlook the qualification—*appreciable*. This great pathologist evidently meant—without any of those well-marked pathological results which usually enter into the post mortem descriptions. A change of function always implies a modification of structure, and most especially so in a tuberculous subject. In such a subject debility, defective digestion, and depraved secretion, for instance, never occurs without implying a modification of structure in its nature tuberculous.

Such, according to my view of tuberculous and scrofulous affections, is tuberculosis, as an essential disease of the blood, to which man and the animals immediately beneath him in the zoological scale, are subject more or less, at all periods of life, from early embryotic development to old age and decrepitude. Many will regard the disease thus described as an abstraction; and it must be admitted, that, as it comes under the cognizance of the practitioner, it is rarely made the subject of his consideration and treatment until some local affection of a particular tissue or organ has proceeded so far as to complicate its symptoms; and still more rarely does it proceed to a fatal issue without some local affection having supervened. Nevertheless, throughout the progress of all the local diseases constituting varieties of tuberculosis, the symptoms and characteristics of the general affection may be recognized; it occasionally happens, that tuberculosis proceeds in the adult to the last stage of marasmus and a fatal issue without hæmoptysis, the aggregation of tubercle, or any obvious local affection. This is a more frequent occurrence in the early periods of life. It frequently happens, also, that some local affection—as tubercles in the lungs—supervenes, but of so circumscribed an extent, that it interferes little with the functions of the organ or the general symptoms of tuberculosis or of the tuberculous predisposition, and from hygienic or other causes the general affection subsides, and nature renders inert the local mischief by a cretaceous formation or a fibrinous deposit. Occasionally the local affection is too trivial to compromise life, and yet the patient goes on dying of the general disease. This frequently happens in children, and sometimes in adults, as proved by symptoms before death, and the existence of too circumscribed an organic affection, detected *post mortem*, to account for the death; but the most frequent result

is, that organic disease sets itself up, and complicates and very materially modifies and precipitates the symptoms, progress, and termination of the general affection.

The essential condition of the blood, upon which the signs and symptoms of tuberculosis depend, is still a problem. In fatal cases one or more organs, as the lungs, the brain, the mesentery, and the intestines, have generally become so far affected as to be incompatible with the continuance of life. In a future chapter the special pathology will be fully considered, and, to complete the history of the disease, the influence of the various organic affections over the original disease, and in the production of the usual fatal termination ought to be estimated; but it may be here stated, that the diseased condition of the blood, the deterioration of the circulatory and more stationary fluids and solids, the emaciation, and the failure of vital force, are of themselves, in this general disease, totally apart from any special affection of an organ, fully adequate to produce such a result, and there can be no doubt that, in many instances, death is as much the consequence and the natural termination of the general disease as of disease of any vital organ.

CHAPTER III.

ON TUBERCULOUS DEPOSITS.

Under this head I include the morbid secretions and deposits which appertain essentially to a tuberculous state of the blood. Whenever these secretions present the characters about to be described, or from the moment that tuberculous deposits occur, according to the organ or tissue affected, the symptoms of the general disease are liable to become complicated, and the case assumes the form and character of one of those varieties which have been regarded, both theoretically and practically, as so many distinct or idiopathic affections, as well exemplified by the diseases already enumerated.

SECTION I.

TUBERCULOUS OR SCROFULOUS PUS.

Pus is a secretion from the blood, consisting, it is scarcely necessary to remind the pathologist, when it first exudes from the vessels, of a fluid more or less closely resembling the liquor sanguinis. To this fluid the term "liquor puris" has been applied. As compared with the liquor sanguinis, it is possessed of a low power of organization, and forms, very quickly after its exudation, into a thin fluid resembling the serum of extravasated blood and an organized microscopical globule, known as the "pus corpuscle," and composed of protein compounds. The fluid resembling serum and the corpuscle, together constitute the bland, apparently homogeneous thick liquid, so easily recognized as laudable or normal pus.

As the blood from which the liquor puris is derived, and the vessels which it must permeate are subject to variations in structure, and in their vital powers and properties, so pus is liable to considerable modifications in colour, consistence, chemical and molecular composition, and other qualities, according to the tissue or organ in which it is secreted, the age and constitution of the individual, or the particular disease in which it occurs; and the state of the blood, under all these circumstances, exercises the most direct influence over the characters which it presents.

There is nothing in tuberculous blood absolutely to prevent the secretion of a blastema susceptible of transformation into true pus, as happens, for instance, in some gangrenous and scorbutic diseases. The tuberculous condition of the blood is, on the contrary, extremely prone to the production of pus, and in the most aggravated forms of tuberculosis, this liquid will form in abundance to the last. As, however, there is no product of the animal economy which exhibits changes of the blood sooner than pus, where the blood is tuberculous, a very great tendency to the formation of unhealthy pus obtains. Tuberculous blood, wherever formed, most frequently produces pus so much changed in its general characteristics, that it can be distinguished with the naked eye, by the most cursory observer, as tuberculous or "scrofulous."

As the minuter shades of deterioration of the blood in tuberculous individuals are with difficulty tested by experiment, so is it with pus; chemistry has frequently failed to detect these differences; nor has the investigation been very diligently pursued. So far as observation and experiments extend the following facts are to be gleaned.

Tuberculous pus whether derived from forms of disease denominated scrofula, or from tissues in which tubercle has been deposited, is in general more fluid than laudable pus, corresponding with the aqueous state of the blood; and its coagulable or protein constituents are more of a caseous quality, corresponding, in some unknown manner, with the vitiated condition of the liquor sanguinis. This fluid and caseous condition destroys the homogeneousness of the fluid, and renders tuberculous pus liable to become grumous; hence it frequently resembles coagulated milk, and evinces a disposition to separate into solid and fluid parts, or to present the appearance of cheesy matter floating in an albuminous fluid. The fluid portion is sometimes tinged with the colouring matter of the blood, owing to the deteriorated state of the red corpuscles, and their tendency to exosmose or dissolution while stagnant in the congested vessels of a part—hence a sanguineo-flocculent appearance. Its fluidity, after the formation of the pus corpuscle, disposes its albumino-caseous portion more readily to solidification than healthy pus, owing to the facility with which the fluid is absorbed, and this tendency interferes with the usual healthy and

reparative results of suppuration, by the formation of heterologous solid deposits of variable characters.

Dr. Glover has furnished the following analyses of scrofulous pus.*

1. From an abscess above the manubrium of the sternum. It was fluid; alkaline; specific gravity 1033.48, and contained no large masses of flaky matter.

In 100 parts	Water.....	85.900	—	85.900
	Solids	14.100	—	
	Fats			1.575
	Extractives soluble in water, pyin			2.450
	Alkaline and earthy salts, traces of iron			1.125
	Albumen and loss			8.956
				100.

2. From an abscess in the leg. Fluid mixed with curdy and albuminous matter. Granular under the microscope.

In 100 parts	Water.....	89.27	—	89.27
	Solids	10.73	—	
	Fats and ext. by alcohol			1.60
	„ „ by ether (cholesterine) ..			.51
	Extractive matters by water			1.50
	Albuminous matter and loss			6.15
	Earthy and alkaline salts			.97
				100.00

3. Thin pus mixed with curdy matter from a scrofulous abscess of the back.

In 100 parts	Water.....	90.8	—	90.8
	Solids.....	9.2	—	
	Alkaline salts and loss			.5
	Chlorides			.2
	Phosphates			.1
	Other constituents			8.4
				100. 0

On comparing these with the collection of analyses of pus contained in "Simon's Animal Chemistry," it will be found that the proportion of albumen is greater, and that of the fatty principles less; but the analyses of pus generally are so confused owing to little or no distinction having been made between pus secreted in subjects perfectly free from or affected with tuberculous blood that little can be made of them.

* The Pathology of Scrofula, p. 81.

The physical properties as presented to the naked eye are even now the most distinctive of tuberculous pus. I witnessed the autopsy, in the Consumption Hospital at Bromptom, of a girl, æt 16 years, in whom the lungs were throughout tubercular—there was evacuated from a large vomica several ounces of uncombined "scrofulous" pus, consisting of a very thin, slightly yellowish, white, opaque fluid, containing numerous caseous looking shreds and clots. The same day I discharged by puncture from an abscess in the thigh of a scrofulous child 4 years old many ounces of a fluid similar in its appearance. These two fluids could not by their physical qualities have been distinguished from each other.

The qualities of tuberculous pus are frequently disguised by admixtures with the colouring matter of blood, which converts the serous fluid into a mild kind of *ichor;* or with blood, with the debris of the surrounding tissue, or with other secretions. When pus is discharged from the lungs by tuberculous subjects it is liable to be mixed with mucus, with the foreign matters just described, with the grey matter of the lungs, and occasionally with tubercle in the form of white, yellow, or brownish-yellow, irregular, very soft masses, varying in dimensions from the size of a grain of sand to that of a hemp seed. Pus from tuberculous glands is also liable to similar modifications.

According to some pathologists tuberculous pus exhibits peculiarities in its earthy and saline constituents. Rokitanski describes it as acid. Gendrin states that it contains more soda and chloride of sodium than ordinary pus. Preuss confirms its caseous character, and remarks on its analogy in this respect to tubercle. Andral also remarks, that it has often a tendency to assume the appearance of tubercle.

Tuberculous pus, as it presents itself to the eye, is occasionally thicker than ordinary pus, and bears a closer resemblance to curd, as in scrofulous glands and abscesses, and in vomicæ; and, in these respects, differs from pus produced by inflammation in healthy subjects.

Vague as our knowledge is of the essential difference between tuberculous and laudable pus, the facts are sufficient to establish in the former qualities analogous to those of tubercle, as will be seen when the characters of the latter have been described.

SECTION II.

THE MORE SOLID DEPOSITS.

Tuberculous deposits, whether resulting from suppuration and the absorption of the more fluid parts of pus, or without any inflammatory or suppurative process, exhibit very great anatomical variations. They may be dense or firm, or soft and crumbling like new curds, or lardaceous; but, according to Vogel, whatever physical character they present to the naked eye, they have a general uniform microscopical character. They consist of three parts;—1. An amorphous stroma; 2. Molecular granules; 3. Undefined cells and cytoblasts from a 7200th to a 3600th of an inch in diameter. The granules consist of protein compounds mixed with calcareous salts and fat, being distinctly interspersed with fat globules.

The cicatrices formed after tuberculous abscesses and ulcers, whether external or internal, are liable to be very imperfect, and to present peculiarities in their appearance. The blastema derived from the blood being vitiated, the primary cellular formation is irregular, and the areolar tissue imperfect. The false membrane thus produced frequently contains the above-mentioned granules and cells, the cicatrices are slower in their formation, and, from the imperfection and irregularity of their structure, they present a peculiar wrinkled and puckered appearance, unequal portions of skin frequently projecting or complete bridges being formed. This is often observed over the site of tubercular glands which have suppurated. Similar appearances are shown by Dr. Glover, in a cicatrix in the lungs.* The resemblance between the cicatrix in the lung and the appearance of a scrofulous scar of an external part is remarked by Dr. Glover as being particularly striking.

The epigeneses of areolar tissue, vessels and epithelium, in the process of granulation and healing, are all imperfect when the blood is tuberculous; and we shall find, in the special pathology of the disease, that the malnutrition of these tissues gives a special character to tuberculous sores generally.

SECTION III.

TUBERCLE.

This is a peculiar amorphous product of tuberculous blood. In its very earliest stage it has been described as a minute white

* Lib. cit., pl. i., fig. 9; also at p. 165.

cloud, placed in healthy parenchyma, and imperfectly circumscribed, with points proceeding from the cloud, which in process of time coalesce or become enlarged. From the earliest moment that it can be observed as a distinct pathologico-anatomical element, it occurs in the form of particles, larger than the air-cells of the lungs, and presenting the following characteristics.

The particles are solid, opaque, or slightly transparent, more or less dense and friable, somewhat rounded, and, on close examination appear to send out ramifications from their periphery which, with the particles themselves, are of a greyish or yellowish colour, dull aspect, or free from glossiness. They are at first extremely minute, and fill up the interstices of the elementary tissues, but appear to have no other connection with them, rarely exceeding the size of a pin's head, but gradually, and sometimes rapidly, increasing in bulk.

The pabulum of their formation is derived from tuberculous blood. As healthy blood supplies a blastema or succus nutritivus for healthy nutrition, tuberculous blood supplies a tuberculous liquor from which tubercle is formed. Other products of tuberculous blood, when the structures become inflamed, or otherwise diseased, as pus, coagulable lymph, false membrane, &c., are liable to be more or less mixed with, or even wholly superseded by, the deposit of tubercle.

On microscopical examination, tubercles are found to be composed of the three elementary constituents of tubercular deposits generally. I. A semi-transparent, greyish yellow, amorphous, vitreous, solid stroma, occurring in masses, and having a microchemical correspondence with coagulated fibrine, but never containing fibres. This has been otherwise described as an interglobular hyaline substance. II. Molecular or elementary granules, varying from 1-10,000th of an inch in diameter to an inappreciable minuteness, generally rounded and congregated in masses, presenting a brownish tint. These masses occurring in the stroma, are differently constituted. *a*. Some appear to be modified protein compounds;—*b*. Others consist mainly of fat;—*c*. A third kind are principally calcareous salts, consisting of carbonate and phosphate of lime. III. Imperfectly developed cytoblasts, and cells,—the cells being in general very defective, of an irregular shape, rarely round or oval, frequently angular. Lebert and Dr. Hughes Bennett state that they never contain nuclei; but the

former describes from four to ten granules in their centre. Vogel and Gulliver describe them as nucleated; a distinct nucleus, however, being rarely to be recognized. Henle states that these corpuscles are nothing more than the so-called *elementary corpuscles,* and particularly that variety which becomes pale, and dissolves in acetic acid. He recognizes, however, in other cases, limpid cells of larger size furnished with a nucleus; more rarely with several nuclei. Although Schultz and others deny that cells are essential to tubercle, conceiving that they occur only in the latter stages, and indicate the formation of pus, the existence of these bodies has been generally admitted; they are regarded generally as cells in a low stage of development, and by most pathologists as an invariable and peculiar element of tubercle.

I have never had any difficulty in satisfying myself of the existence of the very characteristic tubercle corpuscles, in the numerous examples of tubercle I have examined.

The amorphous substance is present from the moment tubercle can be recognized as a solid deposit, and the greater part of the granules are also present from the first; the imperfect cells and cytoblasts make their appearance gradually. These three elements are observed in individual cases, in very different proportions; the protein granules most frequently predominate; sometimes the calcareous granules prevail; the fatty molecules are rarely in excess; sometimes no trace of cells can be discovered; and, at others, the whole mass of tubercle appears to consist of cytoblasts and cells.

I have stated, that tubercle is generally viewed as independent of the original tissue, but there is a relation which it bears to it which must not be overlooked. The tubercular material does not appear to be a substitute for the materials of the tissues. The tissues may be nourished, and tubercles may be formed from the same blood or the same blastema, and yet, although the tissues are imperfectly nourished from the tuberculous blood, they are not *converted* into tubercle. Microscopical observation seems to establish this point. Moreover, so long as the blood or liquor sanguinis merely nourishes the structures imperfectly, there is no such thing as tubercle. It is not until the blood exudes with the succus nutritivus, some combination of elements incapable of transformation into tissue, that an aggregation of tubercles takes place. When a tuberculous state of the blood exists, and continues unchecked, certain tissues are first degraded in their

nutrition and organization, and then, the disease of the blood progressing, tubercles may form in the greater number of the tissues or organs of the body under the operation of various exciting causes. The original tissue ultimately becomes destroyed by the operation of mechanical and vital causes. Thus, when tubercle fills contiguous air-cells, or contiguous portions of the parenchyma, the parietes are destroyed by pressure; if it be accumulated in several adjoining vessels, as in those of the parietes of the air-cells, or in the minute bronchial tubes, the parietes of the vessels are also destroyed by pressure; and this destruction is promoted by the low degree of vitality and the malnutrition of the respective tissues, the whole favouring the production of tubercle in the mass.

This question, whether the original tissue is replaced by the tubercle or absorbed in consequence of the tubercular deposit, has been much discussed by pathologists. To render myself more explicit I should say, that probably both processes are in operation. The physiological relation of molecular absorption and deposition are absent in the tubercle and the aggregated particles act as a foreign body. They produce pressure upon the surrounding vital solids and consequent absorption. At the same time the blood which supplies the material of tubercle supplies the nutritive elements of the surrounding tissues—viz., tuberculous blood. So that, while the particles of tubercle are aggregating into appreciable masses the living tissue itself is suffering tuberculous degeneration, the healthy tissue is replaced by diseased tissue, although not by tubercle, and hence, viewing tuberculosis as a disease of the blood both these processes must be in operation. If it were not so tubercle would be comparatively innocuous.

Some organs and tissues are much more liable to tubercular deposit than others. We have remarked, on the authority of Dr. Carswell, on the great liability of the mucous tissues. In the adult, the lungs and the intestinal canal are much more liable to them than the brain or liver. Those organs which are most liable in the adult are not always so in children, so that we have a different scale of susceptibility for early life. In some vascular organs, as the salivary glands and ovaries they are very rare. They are equally rare in the œsophagus, the inner coats of the vessels, and the vagina. Again, in each organ tubercle is most liable to be deposited in some particular point; "in the lungs, it is first

separated and concentrated in the apices and upper third of the superior lobes; in the pia mater, the portion investing the base of the brain, from the optic commissure to the pons and medulla oblongata, is the part attacked; in the brain, the grey matter and the structure contiguous to it; in the osseous system, the spongy bones; in the intestinal mucous membrane, the lower part of the ileum; in the laryngeal mucous membrane, that portion which invests the chordæ vocales; in the testicles, the epididymis; and, in the female sexual apparatus, the mucous membrane lining the tubes and the fundus of the uterus." On the other hand, the deposit of tubercle, in a few cases, meets with limits beyond which it rarely passes; thus, tubercle deposited in the larynx scarcely ever extends to the pharynx, and uterine tubercle is limited by the os uteri, and leaves the cervix and vagina unaffected. Many of the above and other circumstances lay the foundation for numerous varieties of tuberculosis as a disease of the blood; as tuberculosis pulmonalis, glandulosa, peritonei, &c. &c., which would require to be fully treated of, in order to complete the history of the disease.

The detailed history of tubercle will be given under the following heads :—

1. The primary seat of tubercle.
2. Its origin and primary development.
3. Its consistence, external configuration or form, and the varieties of tubercular matter.
4. The classification of tubercles and the relation which subsists between the grey and yellow varieties.
5. The phases of tubercular development.
6. The chemistry of tubercle.

A.—THE PRIMARY SEAT OF TUBERCLE.

Much has been written, and great differences of opinion were for a long time entertained, as to the true seat of tubercular aggregation. The whole subject has been very completely investigated, and we are indebted to the labours of Carswell, Andral, Rokitanski, and other modern pathologists, for the tolerably accurate knowledge we now possess. The position which tubercle occupies in the various organic structures, is confirmatory of the view taken in this work of its origin from a morbid blastema, derived from the vitiated liquor sanguinis.

Andral laid it down as a principle, that tubercles may be developed in any of the tissues, but their most usual seat is the "cellular tissue;" and it appears to be clearly demonstrated, that their deposition is independent of any particular structure, since they have been actually found in the greater number of the organs and tissues of the animal body. Their most general position, however, is the areolar or cellulo-vascular tissue of the organic textures; the seat of nutrition and secretion. In the lungs they occur within the air-cells, in the minute bronchial tubes, and in the parenchyma. Andral also observed that the air-cells being dilated, their walls were thickened, and presented a peculiar yellow tinge, the tinge being deeper in some points, and there were a number of yellow round bodies, indicating the change pending the secretion of tubercle, in the thickened parietes. Tubercles, in fact, may be detected by the microscope, and even with the naked eye, in the parietes both of the air vesicles, and of the minute bronchial tubes opening into them. The precise seat of tubercle of the lung was accurately determined by Mr. Gulliver in a child 11 years old—it partly filled the interior of the cells, and was partly in the filamentous tissue exterior to them.* They are probably often seated between the folds of the basement membrane in which the vessels ramify. The subserous, submucous, and intermuscular tubercles, are evidently developed in the areolar tissue. In the spleen, brain, liver, kidneys, testicles, and lymphatic glands, it is sometimes difficult to prove that the morbid product belongs to the areolar tissue. Tubercles are formed in the air-cells, in the interior of tubes and cavities lined with mucous membrane, and in the mucous follicles, without any ulceration; which shows that they are not only developed in the areolar tissue, but also in other tissues. The more particular seat of intestinal tubercles is manifestly the areolar texture between the muscular and mucous coats; in tubercular meningitis their seat is mostly beneath the pia mater especially in the neighbourhood of its vascular arborisations, or occasionally beneath the arachnoid membrane. Carswell regards the mucous tissue as more susceptible of tubercular deposition and aggregation than any other structures in the human body; so that, in whatever organ the formation takes place, if the mucous tissue forms a part of that organ, it is either

* Edin. Med. and Surg. Journ., vol. lx., p. 161.

the exclusive seat of the tubercle, or it is more extensively affected with it than any other of the systems or tissues of the same organ; he further states that the free surface of the serous membranes, the parenchyma of organs, and even clots of blood, are obnoxious to it, and that the tubercular matter fills the interstices of the elementary tissues closely; perfectly investing, but not displacing or altering them; and it is much less frequent in the serous than in the mucous tissues. In rare cases it is deposited between the coats of the arteries, a fact which, as remarked by Lebert, indicates its origin from the blood. Tubercles are sometimes deposited within the blood-vessels; but, notwithstanding the opinion which has been maintained, that this is their original seat even when occurring in the lungs, the occurrence is extremely rare. Wherever *liquor sanguinis* exudes, or coagulated lymph proceeding from it, occurs, there may tubercle be met with; and Rokitanski remarks, that its seat "may be any point of any tissue external to vessels; in short, wherever there is a capillary system, there tubercle may be separated. It must be deposited at or very near to the place of exudation, in consequence of the highly coagulable nature of the blastema; hence it occurs very rarely in such tissues as cartilage, which are merely nourished from a prolonged saturation of their substance by plasma."

B.—THE ORIGIN AND PRIMARY DEVELOPMENT OF TUBERCLE.

The facts before us can, I think, leave no doubt of the origin of tubercle from the blood. The most rational view, although questioned by Andral, but admitted by many pathologists of the highest reputation, and deduced from the facts relating to its seat, from the microscopical description, and from the chemistry of tubercle, is—that the formative material is usually a cytoblastema secreted from morbid blood in a fluid form, by the capillary vessels, and that the aqueous particles are subsequently absorbed. Although the fluid has never been observed or collected, and we have no direct observation to prove either that it differs from or resembles the healthy blastema—the micro-anatomical history already described and the chemistry which will subsequently be fully given, lead to the just inference, that the one is a modification of the other.

When the deposition has once commenced the tubercular material has the power of drawing particles for increase from the

tuberculous blastema which surrounds it, and probably from the blood itself; and there is a constant tendency to aggregation by the law of analogous formation; an increase of the volume of the mass taking place in consequence. This increase of bulk is gradual, but sometimes very rapid. The tuberculous liquor being exuded and infiltrated among the tissues, the increase takes place mainly by the juxta-position of particles around a primitive nucleus of tubercle; the tubercles, as already stated, in no instance forming part of the molecular tissue, but the vessels and fibres of the part ultimately becoming compressed, and the former emptied and impervious; hence, if vessels or fibres be found in tubercle, they are the remains of the original structure.

Although the increase of tubercle proceeds mainly by the juxta-position of molecules merely deposited, yet, in so far as the morbid product exhibits traces of cell-growth, however imperfect the cells, the growth may be partly produced by the intersusception of other particles.

C.—THE CONSISTENCE, THE EXTERNAL CONFIGURATION OR FORM, AND THE VARIETIES OF TUBERCULAR MATTER.

Tubercle is uniformly described as a solid; at the same time, all analogy leads to the inference, that its secretion takes place originally in a fluid form. In truth, its micro-anatomical character cannot be accounted for on any other supposition. We must accordingly admit that its watery part is absorbed, and hence it presents various degrees of consistence. After its deposit and aggregation to a considerable extent, it may become firmer, as frequently happens in the lymphatic glands; or it may become softer by the infiltration of a larger portion of fluid. Its consistence is various, also, according to the organ or tissue in which it is enveloped. Tubercles of the brain are frequently harder than those of the lungs or intestines.

Tubercular matter occurs either in the form of distinct *tubercles*, or as tubercular infiltration, and presents varieties arising from different shades of colour and degrees of opacity, consistence and solubility, arising from varying proportions of stroma, molecules, nuclei or cells, and other causes. Of these varieties the following have been described:—

1. *Grey Granulation.*—The simple fibrinous tubercle of Rokitanski. This is the most frequent form. Tubercles of this kind

are of a greyish-white colour, semi-transparent, and homogeneous, having the appearance of coarse scalded groats, but firmer, and communicating a granular or fibro-granular sensation to the finger on pressure. Their section is smooth and cartilaginous. Their size is pretty uniformly intermediate between that of a grain of mustard and a millet-seed; or varying from the size of a pin's head to that of a pea. They consist of the amorphous stroma already described, and of the cellular formations, but are deficient in granules, which explains their degree of transparency, their colour, and smooth section. Lebert states, that from their earliest formation they contain tubercle cells, and are, therefore, a genuine form of tubercle; by others they are regarded as another form of abnormal nutrition. Henle describes them as consisting of imperfectly coagulated fibrine.

2. *Yellow Tubercles.*—These are the croupo-fibrinous tubercles of Rokitanski. They are yellow, thoroughly opaque, cheesy, or caseo-lardaceous, in the form of roundish nodules, or of irregular, nodular, ramifying masses; or, when occurring on free surfaces, having the form of glandular nodulated layers, for the most part exceeding the size of the grey granulations, being sometimes as large as a hemp-seed, and presenting an irregular granular section; the whole of these characters apparently depending upon an excess of granular matter.

3. *Tubercular Infiltration.*—This occurs more diffusely than the other forms, being infiltrated among the tissues in a less regular manner, owing apparently to the rapidity and abundance of the tubercular secretion within a circumscribed space. It forms masses of irregular shape in parenchymatous structures and layers of variable thickness in membranous structures.

4. *The Gelatiniform Infiltration or Albuminous Tubercle.*—This is a very humid, colourless, or reddish form of tubercular matter, usually infiltrated to a small extent in the intervals of distiuct tubercles. Laennec was of opinion, that by degrees it is transformed into the grey granulation, and, according to the views of this eminent pathologist, the latter ultimately becomes crude yellow tubercle; he remarks, that where this jelly-like matter is most transparent and fluid, small yellow points are frequently observed in it, consisting evidently of crude tubercle; and that the conversion of this as well as the grey granulation into yellow tubercle is sometimes so rapid that their traces cannot be detected,

although there can be no doubt that the one originated in the other. Other pathologists have denied that this matter is tubercle, considering it a simple product of inflammation. Rokitanski regards this albuminous affection as being always indicative of a curative tendency. In the numerous bodies of children examined by Rilliett and Barthez, they met with this variety once only.

5. *Tubercular Dust (poussiere).*—Tubercle is in very rare cases deposited and remains as an accumulation of the minutest specks, so small and so numerous that they appear like the very minute eggs of an insect sprinkled over the tissue, and at other times scarcely to be detected with the naked eye. The specks are nevertheless distinct, sometimes elliptical, sometimes oval, sometimes perfectly round. Sometimes they are deposited in small groups. Rilliett and Barthez state that they have occasionally observed them united together so as to form small tubercular masses, and in this case pressure would sometimes bring a small drop of blood from the mass, a sure index that the vessels in the midst of them were still entire.* At other times it was impossible to determine the presence of vessels. Andral also detected this variety of tuberculization, especially in the lungs. This kind of tubercle differs from that which is called miliary probably in volume only.

The nomenclature of the varieties of tubercle, employed by different pathologists, is so confused, owing to the different views entertained of the nature of these varieties, that it is necessary to bear in mind their synonymes. The following are the terms employed in the present work :—

1. *Grey Granulation.*—The miliary tubercle and miliary grey granulation of Bayle. The semi-transparent granulation ; also nascent tubercles of Laennec. The simple fibrinous tubercle of Rokitanski.

2. *Miliary Tubercle.*—Sometimes limited to the granular tubercles or miliary granulations of Bayle, or the miliary tubercle or semi-transparent grey granulation of Laennec. According to Rilliett and Barthez it may be grey or yellow. It refers only to size and form.

3. *Yellow or Crude Tubercle.*—The crude tubercle of Laennec and almost all pathologists. The croupo-fibrinous tubercle of Rokitanski.

* Des Maladies des Enfan, vol. iii., p. 14.

4. *Yellow Granulation.*—The yellow tubercle of a definite size and form, employed by Rilliett and Barthez, and others.

5. *Tubercular Infiltration.*—This may be grey or yellow.

6. *Gelatinous Infiltration* or *Albuminous Tubercle.*—Laennec.

7. *Tubercular Dust.*—This may be grey or yellow.

Although for a long time it was believed that these varieties occur in the lungs only, some of the highest authorities now admit that they are met with in nearly all the organs. Both grey and yellow tubercle have been observed repeatedly in the serous membranes of the chest, abdomen, and brain; in the mucous membranes; in the glands, the liver, spleen, and kidneys; and in the bones. The history of tubercle is essentially the same in whatever part of the body it may present itself. There are, however, great differences presented, as to colour, transparency, and consistence, especially by grey granulations. Rokitanski has made the important observation, that every degree of commixture of the blastemata of grey and yellow tubercle, and of a perfectly organizing or fibrinous blastema occurs, giving rise to innumerable varieties of this pathological epigenesis. The colour of tubercles may be modified by various circumstances. Jaundice stains them yellow, particularly on their surface; gangrene in their vicinity gives them a brownish or dirty brown colour; black pulmonary matter, described in a future section, is sometimes deposited with them, and may alter their tint. Laennec thinks their grey tint in the first stage is owing at least in part, to a small portion of the same black matter.

Dr. Carswell points out that the round form which tubercle is said to present is a purely accidental circumstance, is common to many other morbid products, and expresses one only, and perhaps the least important, of the many forms which this matter assumes in the several organs in which it is found. Thus, from the homogeneous nature of the cerebral substance, and the equal resistance which it opposes to the accumulation of the tubercular matter, the form of the latter must be nearly round. Such, also, and for similar reasons is its form in the areolar tissue. But in other organs the form is as various as that of the parts in which it is contained. It assumes the outline of a shut or open globular sac, if confined to the secreting surface, and of a solid globular tumour of various sizes, if it fills completely the cavity, of the air-cells; and, for similar reasons, it presents in the bronchi a

tubular or cylindrical form, having a ramiform distribution, terminated by the cauliflower arrangement of the air-cells. In the mucous follicles its form is similar to that which it receives from the air-cells. In the biliary system it has a racemiform distribution, from its being contained in the ducts and their dilated bulbous extremities. In the cavity of the uterus and Fallopian tubes, the calyces and pelvis of the kidneys and ureters, in the seminiferous ducts and prostate gland, in the lacteals, lymphatics, and their glands, it is moulded to the respective forms of each of these parts. On the surface of serous membranes, whether natural or accidental, it may have either a globular or lamellated form, as the secretion in which it originates may have taken place in distinct points, or from a continuous surface of greater or less extent.

When the secretion of tubercular matter takes place in such a manner as to become disseminated throughout a considerable extent of an organ, as when it is said to be infiltrated, it has then no definite form, unless it occupies, for example, the whole of the lobe of a lung, when it assumes that of the affected lobe. The granular arrangement in the lungs is owing to the accumulation of the morbid product in one or more contiguous air-cells; and the lobular character which it sometimes presents in the same organ is produced by its being confined to the air-cells of a single lobule, the neighbouring ones being healthy. Examples of these three forms are given by Dr. Carswell in his 55th Plate.

D.—THE CLASSIFICATION OF TUBERCLES AND THE RELATION WHICH SUBSISTS BETWEEN THE GREY AND YELLOW VARIETIES.

Authors have materially differed in the distinctions drawn of tubercle, and in the classification they make of the varieties which it presents. Bayle regarded the grey granulation as a distinct variety, and this opinion has been held by many subsequent writers. Laennec and his followers regard this merely as the germ of all other varieties. The lungs are occasionally studded with grey miliary tubercles, nearly of the same size and character throughout, without any yellow tubercle, as if they really were a distinct disease. Most frequently in these organs, a portion of the tubercles are in the miliary state, another portion progressive, and another mature, as if they were the same in kind, but in different stages of development. The appearance which they

present is again, in some, as if composed of albumen or fibrine; in others, of ill-conditioned, curdy material, resembling cheese; and in a third kind, like moist mortar, from containing calcareous matter. All these appearances are sometimes found in one and the same case, as if they typified successive changes in tubercles originally of the same nature.

I have already stated, from Carswell and other pathologists, the basis upon which variations in the form and appearance presented by tubercular deposits generally are founded. The most important question respects the relations which subsist between the grey induration and the yellow tubercle. Three forms of the grey matter are described. 1. Grey granulations or small roundish tumours. 2. Grey masses surrounding cavities. 3. Large grey masses, inclosing a few yellow tubercles. Louis states that he hardly ever met with a case of yellow tubercles without the presence of grey granulations. Laennec maintained that the original form of tubercle is the grey, semi-transparent granule; he describes the transition of grey to yellow tubercle. A small yellowish opaque speck appears in the centre of the tubercle; or, according to Andral, sometimes on the surface, which speck gradually enlarges and finally involves the whole. On dividing a mass of several tubercles that have coalesced, the small yellow points may be recognized with a zone of unchanged grey matter around them, and after a time the whole is converted into yellow tubercle. Laennac likens the grey matter to the primitive animal jelly, a sort of matrix destined to receive materials foreign to the organization of the part, the consequence of some aberration of nutrition.* Chomel and Andral disbelieve in the identity of the two varieties, and the latter has the remark, that if this identity existed, grey granulations should have been found in every part of the body where tubercles occur; whereas, they have not been observed in the lymphatic glands, brain, liver, spleen, submucous, or intermuscular tissues, wherein yellow tubercles are so frequently aggregated. It is now, however, known that grey granulation does occur in most of these situations. Blakiston, with other respectable authorities, considers the grey induration as an imperfectly organized substance, which may occur independently of tuberculosis, but which, in tuberculosis, descends still further in the scale of organization, and is converted into, or displaced by,

* On Diseases of the Chest. Translated by Dr. Forbes. Ed. iii., p. 281.

tubercle. In this sense it may, in some cases, be the first stage of tubercle, but not a stage, as supposed by Laennec and Louis, through which tubercle must necessarily pass before acquiring its own peculiar character; nor must it, of necessity, be followed by tubercle. He regards it as the product of chronic inflammation, yellow tubercle being developed subsequently to the inflammatory process; and many interesting cases are given to establish this doctrine. It is considered that it is precisely the same as when plastic lymph is first secreted as a consequence of inflammation, and tubercles are formed in the resisting membranous bands, since these bands must have existed before the tubercles could have been deposited. In further proof of the non-identity of grey granulation and yellow tubercle, Dr. Campbell has attempted to show, that the chemical re-actions of the former, and of yellow tubercle, are not the same, the one being more prone to putrefaction than the other, and the action of alkalies pointing to some differences; but these differences (admitting them to exist) give no positive information on the fundamental question. Lebert has more recently advocated Laennec's view; he states, that the grey granulation is the genuine form of tubercle, its transparency and colouring being produced, partly by the close juxta-position of the tubercular corpuscula, in consequence of uninjured pulmonary fibres, partly by the absence of a large proportion of granular matter; the tubercle corpuscles being kept together at the beginning, in serous membranes, by fibres of the membrane; but as soon as, by the increase of tubercular secretion, the fibrous element is greatly compressed, the tubercles become yellow.

It does not appear to me that even yet the precise relation between grey and yellow tubercle has been made out. The statements of Vogel, and other microscopical anatomists, that grey granulation is composed of the same elements as yellow tubercle, the amorphous stroma and corpuscles being more numerous in proportion to the granules in the former, and the scarcity of the granules accounting for its transpareney, must be received. But this does not appear to me to affect the question, whether the grey induration in particular is or is not necessarily the rusult of chronic inflammation. My own view of the facts is as follows:—A form of grey granulation is a product of chronic pneumonia independent of tuberculosis. (Laennec.) This may lose its granular character so as to assimilate it in appearance to grey tubercular

infiltration; but in other respects it differs very materially from the latter; it has an opaline appearance, is traversed by white, thick, areolar septa, quite as distinct as those of pneumonia, and is more compact than the grey matter deposited from tuberculous blood. It will be shewn in future chapters that tubercles may be developed in the products of inflammation—in plastic lymph, for instance; they are especially liable to occur in grey granulation, whether this be regarded as an inflammatory exudation or not. Now I hold, that neither in lymph nor in grey granulation could tubercle occur unless the blood were in a tuberculous state. In the case of plastic lymph, I consider it most probable, that the aggregation of tubercle takes place from a nidus deposited from the exuded liquor sanguinis and operating as a focus of attraction; and that its increase may be promoted or retarded by an increasing or diminishing tuberculous state of the blood, the morbid blastema being more or less charged with the essential material of tubercle, as the blood may be more or less tuberculous. Grey miliary tubercles may undoubtedly occur without inflammation; but if the grey induration be a product of inflammatory action, it must still be a product from tuberculous blood. It is a product of inflammation in tuberculous subjects; and I regard the deposition of yellow tubercle in grey matter in the same point of view as when produced in plastic lymph; a more perfect tubercular nidus becomes established within the grey matter, which results in the aggregation of more perfect yellow tubercle. Where both products occur together, the grey matter is the earliest deposit; yellow tubercle is frequently seen within the substance of the grey matter, and undoubtedly frequently takes its place,—thus it may be regarded as an earlier stage of formation, but as yellow tubercle occurs without grey granulation in the lungs as well as in all organs, it is not a stage through which tubercle must *necessarily* pass.

E.—THE PHASES OF TUBERCULAR DEVELOPMENT.

Although tubercle deposited from the diseased blood in tuberculosis, and aggregated in particular organs or tissues, undergoes changes, and produces effects dependent, in some measure, upon the nature of the tissue or the function of the organ in which it is deposited, and also upon the particular exciting cause of the deposition, whether occurring spontaneously or induced by congestion, inflammation, the rupture of a vessel or the like, there are, as

already intimated, certain changes to which the tubercle is subject under whatever circumstances, or wherever deposited; and these changes have received a great share of attention from pathologists.

In some structures, and particularly in the lungs, tubercle may present a vesicular appearance from the very commencement of its existence, but this is attributable to the tissue under which it is deposited. As already described, for the most part it begins by a semi-opaque point, which soon becomes wholly opaque. The morbid deposit may remain latent for a longer or shorter time (from a few weeks to many years, probably,) in this primitive semi-opaque, or secondary wholly opaque state. Tubercles have been met with in subjects of all ages, who have never given any evidence of them during life; at the same time, it is necessary to be extremely cautious in admitting their existence in this state without evidence, as I have no doubt their presence has frequently been erroneously assumed, to account for symptoms which in truth depended, not upon local but upon general disease. Tubercle remaining for any length of time in a latent state depends in a great measure upon the condition of the blood, whether it be more or less tuberculous; or whether, from hygienic causes and more perfect hæmatosis, it may have lost its tuberculous condition. It depends, also, upon the state of the surrounding tissues,—whether, for instance, they are in a perfectly quiescent or in an inflammatory state, or subjected to, or exempted from, the causes of congestion or irritation. In most cases where tuberculous points are scattered over the pleuræ or peritoneum, the serous membrane continues transparent up to these points, and only becomes reddened or opaque when the tubercle has begun to act as an irritant, or to undergo some new phase in its development.

Previous to the commencement of the changes about to be described, an increase of bulk takes place. From the size of a pin's head, a tubercular mass may acquire the bulk of an ordinary orange. When rapid aggregation has once commenced, the process, for the most part, continues, the morbid blastema continually secreted from the blood furnishing particle by particle. In some cases the mass has a tendency to isolate itself, and a cyst becomes organized around it, just as happens in the formation of a pyogenic membrane in a common abscess. The existence of tubercles is in general first declared when they begin to disturb the function of an organ by their size or number, or when some

degree of inflammation is excited; but whenever they are deposited, and have become aggregated into distinct tubercles or masses, as heretofore described, they are liable to undergo particular changes in their nature and qualities, and to produce certain effects in the surrounding tissues. These changes are well distinguished by Lebert as having either a destructive or a curative tendency.

(a) THE DESTRUCTIVE TENDENCY OF TUBERCLE.

This is towards softening and ulceration, which is lamentably the most common result.

1. *Softening.*—Much discussion has taken place among morbid anatomists as to the mode in which softening occurs. Laennec and many of his successors affirmed that it commenced in the centre of the tubercular mass. Andral, Carswell, and the greater number of the more modern writers, describe it as commencing at the periphery, and attribute it to the action of pus and other fluids derived from the surrounding tissues. Those who adopt the latter view exclusively, have given various explanations of the central softening which unquestionably is sometimes observed. Lebert reconciles the whole of these discrepancies by describing four different forms of softening:—

(*a*) Miliary or very small tubercles soften in the centre, without any inflammation of the surrounding parts in the immediate neighbourhood. Softening then occurs without admixture of pus. This form is met with in the lungs, the brain, and the sub-mucous areolar tissue of the intestines. On examining tubercles in this state, caseous granules may be perceived interspersed in a liquid, which are nothing more than the less softened particles where the intermediate granular mass has not at present become liquid.

(*b*) The softening is accompanied by much less complete liquefaction. The tubercle generally becomes friable and granular, this being sometimes only the commencement of liquefaction; at others the tubercle remains for a long period in this state of semi-softening, or passes even into the state presently to be described as cretification. Lebert has observed this more particularly in the cervical and bronchial glands and in the brain. It is much more rarely found in the lungs.

(*c*) There is central softening and peripheral suppuration. During the softening, inflammatory action sets up in the tissues surrounding the tubercle, which terminates in suppuration. The microscope

shows the difference of these two conditions. Disaggregated tubercle corpuscles, unalterable by acetic acid, are found in the centre; in the fluid of the circumference, besides these, pus globules are found, the envelope of which may be dissolved in acetic acid, disclosing a nucleus. This state is sometimes found in the glands, but more frequently in the lungs, in which the pus is also sometimes derived from the eroded bronchial capillaries.

(*d*) There may exist an indistinct mixture of the elements of pus and softened tubercle, and then no limits are to be observed between the two products. This is particularly the case in the softening of tubercular infiltration, as it occurs extensively in the lungs and glands, and more rarely in the subserous areolar tissue.

Rokitanski thus more particularly describes the usual process of softening:—"After the tubercle has existed for some time in a state of crudity, it becomes, as it were, loosened in its texture, and usually increases in volume; it breaks up on slight pressure, and becomes more moist; then changes into a yellowish, dissolving, casein-like, fatty, and viscid matter, and finally breaks up into a thin, whey-like, acid fluid, in which flocks and shreds—the remains of the imperfectly disintegrated tubercle—are observed swimming." * * * "The softening consists in the solution and disintegration of the solid ground-work of the tubercle into a fluid containing an abundance of the minutest molecules. This change is followed by a separation and isolation of the histological elements, which undergo more or less marked alterations by their immersion in the fluid; the cells become distended, corroded, and are finally dissolved; the nuclei shrivel, and assume irregular forms, becoming angular and indented. Finally, in softened tubercle we meet with free fat." *

Thus the softening of tubercle, at least in its early stage, is, for the most part, a mechanical process. I say "for the most part," because, if imperfect organic cells be admitted as an essential constituent, it is difficult to exclude the possibility of some degree of vital molecular action. Inflammatory action is clearly not the primary cause of this softening, although it undoubtedly accelerates the process whenever it occurs. From extensive series of observations in man and animals, Rayer and others record, that the central softening of tubercles never presents pus globules, showing with other evidence, that it cannot be imputed to inflammation. The

* British and Foreign Review, Jan. 1848, p. 174.

peripheral softening, on the contrary, is almost always mixed with pus globules, showing that it is generally attended by inflammation—not of the tubercle, but of the surrounding tissues. The equilibrium between deposition and absorption, in the ultimate structure of an organ, being disturbed, and tubercle being deposited and aggregated as a non-vascular and foreign material, commencing in a point and augmenting mechanically in volume, being in an early stage solid, and thereby excluding the access of air, decomposition is for a certain time resisted. But, at the same time, located in an organism in which a certain temperature is maintained, and a great mass of liquid is in perpetual circulation, it must sooner or later, by the ordinary and universal laws of imbibition, become decomposed. The central part, or that which has been longest deposited, is the first to become altered, and the change propagates itself by centrifugal extension to the molecules more recently formed. Inflammation, although not the primary cause, tends very greatly to accelerate the process.

It has been well observed by Mr. Rainey, in an excellent article on the formation of pulmonary tubercle,* that, as a tubercle increases in size, the central parts become further and further removed from those vessels by which the tubercular matter was in the first instance deposited, and, consequently, these parts will have the greatest tendency to lose their vegetable or cell life, and become softened; the process accordingly begins, in general, if not always, in the centre of a tubercle:—"But it must be recollected, that the geometrical centre of the mass is not necessarily the point furthest removed from the source of circulation; the point may even be on the side of the tubercle, provided (in the lungs) it be the remote cells of a lobule which are occupied by the tuberculous matter, namely, those bounded by an interlobular fissure; in such a case, this part of the tubercle might be further removed from the source of circulation than the centre."

2. *The more complete Liquefaction of Tubercles and Ulceration of the Neighbouring Parts.*—Lebert observes that, in the process of softening, the tubercular corpuscles maintain their integrity, although they become distended, which is the commencement of their disintegration. In liquefaction, the corpuscles gradually lose their individual characters, and terminate by resolving into a fluid which has no characteristic molecules. The surrounding parts,

* Med. Chir. Transac., vol. xxviii., p. 581.

also, alter by degrees, both by the addition of fresh tubercular deposit and by the occurrence of inflammatory action. Previous to this, according to Lebert and most other pathologists, the tissues around the tubercle, under ordinary circumstances, are quite free from any inflammatory appearance. Mr. Rainey gives an interesting demonstration of this: he states, that the perfectly natural appearance of the vessels close to a tubercle, and even of the air-cells containing a small quantity of tubercular matter not sufficient to have impeded the circulation in the capillaries during life, when compared with the tortuous and unequally dilated state of vessels going to air-cells filled with fibrine in consequence of inflammation, are pathological considerations in favour of the non-inflammatory nature of tubercle, and also tend to show that the obliteration of the capillaries is produced by a force which has exerted on them a slow and gradual compression, such as can only be conceived to have been produced by the accumulation of tubercular matter in contiguous cells pressing upon the intervening plexuses.* When, however, the surrounding parts thus become affected, the ulcerous tendency of tuberculosis prevails, and ulceration is the rapid result. In some parts tubercles rarely arrive at the stage of complete liquefaction, as in the nervous centres and their envelopes, the peritoneum, mesenteric glands, pleuræ, spleen, and other organs. On the contrary, the liquefaction and ulceration occur constantly in the lungs, where the ulcers assume the form and are known by the name of vomicæ or caverns, as also in the cervical and axillary glands, where they become scrofulous ulcers, and in the intestines, bones, and sometimes in the liver and kidneys.

Rokitanski's account of dissolved tubercle corresponds very closely with that given from Lebert; he states that it consists—*a*, of a fluid with minute molecules; *b*, of altered and isolated nuclei and cells; *c*, of free fat, in the form of granules, and distinct globules of a larger size.

To complete the history of local tubercular development we should have to describe, not only the aggregation of tubercles, their softening and liquefaction, and the inflammation and ulceration of the adjoining tissues, but the formation of fistulæ and sinuses frequently established in the neck, over the sternum, or in the abdomen, and proceeding from tubercular deposits in the

* Lib. cit., p. 594.

bones, glands, lungs, or peritoneum; but in doing so we should enter too much in this place into the consideration of the local varieties of tuberculosis. All these affections in tuberculous subjects have one important pathological relation,—they all derive their special characters from the particular disease of the blood. In all, tubercle is first aggregated in a crude state, and then softened.* The surrounding parts then become inflamed and infiltrated with pus, the tubercle is liquefied and dissolved, and the inflammation proceeds gradually to the external surface. In this way tubercles of the lymphatic glands open upon the skin; intestinal tubercular ulcers on the free surface of the intestines; pulmonary ulcers in the bronchiæ; and not only are the contents thus discharged externally, but an habitual secretion of tuberculous pus from the morbid blood, with the tuberculous qualities described in a former chapter, is established in the parietes of the ulcer, fistula, or sinus.

In exemplification of the fact, that these processes vary, to a certain extent, according to the tissue and organ in which they occur, I quote the following interesting illustrations also from Lebert, but which my own experience amply confirms. The destruction resulting from the liquefaction of tubercle is most complete in the lungs, and the tubercular matter is either discharged in molecules, or in small masses of softened substance. In the external lymphatic glands more voluminous grumous masses are sometimes discharged, and Lebert once met with an entire tubercle, having the form and volume of a large bean, expelled through a fistula in the neck which he had laid bare. In intestinal ulcers the liquefaction is less extensive, and a very small secretion of pus takes place, but rather an increase of epithelial desquamation and of all the intestinal secretions. The peritoneal surface is particularly exempt from suppuration. In the superficial lymphatic glands pus forms in large quantities, and frequently in similar quantity in pulmonary caverns.

3. *Encysted Tubercles.*—Tubercles are sometimes enclosed, like a kernel, in a capsule or cyst of greater or less density. This has been particularly observed in the bronchial glands. These cysts are sometimes semi-cartilaginous, and are perceptible before the softening of the tubercles; they adhere to the surrounding parenchyma firmly. Before the tubercular matter becomes softened,

* Lebert, lib. cit., p. 17.

it adheres to the cyst, and on removing it the interior surface is rugged, but polished. When the process of softening takes place, the cavities are described as being lined with a false membrane of effused fibrine, proceeding from a delicate vascular net-work, and this appears to be the commencement of that process of cicatrisation which we shall presently have to describe. For the most part, however, as in the lungs, the mere parenchyma forms the walls or boundary of the excavation or vomica.

(b) THE CURATIVE TENDENCY OF TUBERCLE.

1. *Absorption while in a Crude state.*—The possibility of this has been denied without much reason; the rarity of the occurrence is certain. Andral, Carswell, Hasse, and other high authorities believe in it. Demonstrative evidence has been afforded that the material of tubercle is, at all events, partially absorbed in all its phases of development, and in most situations in the body. The animal matter and the liquid are sometimes absorbed, leaving the earthy matter behind. That absorption occurs is also shown by the fact that a tubercular cavity in the lungs is almost always surrounded by crude tubercles; but, when the remains of a cavity are found in a portion of lung, scarcely a vestige of surrounding tubercle is to be seen. The inference is, that the surrounding tubercles are more likely to have been absorbed than expectorated.

Obsolescense and Cornification.—Rokitanski affirms that grey granulation is capable of one metamorphosis only. After it has passed through its condition of crudity, it loses its shining appearance, and increases in density, becoming converted into a small hard lump, and then shrivelling into a tough amorphous or slightly fibrous horny mass. This forms the basis of the complete destruction of the tubercle, and no further change can take place; the process is sometimes accompanied with more or less ossification, in which case the remains of the tubercle consist partly of a horny mass, and partly of bone-earth. Grey granulation, according to this morbid anatomist, never undergoes softening; whenever this process occurs, there is always an admixture of yellow tubercle. So far as the tubercle is concerned, this may be regarded as a curative tendency, and, if its expulsion, or its remaining quiescent in the tissues, could be ensured, it would prove so, but unfortunately it exists for the most part as a foreign material, exciting the blood and tissues to further pathological changes. This change

may occur, either in the granular or the infiltrated form of grey tubercle; if it take place in all the tuberculous matter deposited, the disease of the blood being at the same time arrested, the cure of the tuberculosis is complete, and, if the grey granulation be admitted as the earlier stage of local tuberculous disease, this is one form of natural cure.

3. *The Cretaceous Transformation.*—Cretaceous concretions are admitted to be the remains of degenerated tubercle, although, as remarked by Dr. Blakiston, neither these nor fibrous nodules ought to be set down as invariable evidence of the pre-existence of this morbid deposit. The formation of these concretions has been traced through all its stages, from crude tubercles to masses of a stony hardness. The first stage of the process, according to Lebert, appears to be an increase of density in the tuberculous mass. It becomes less cohesive and harder, losing its yellow and assuming a whiter tint. In the second stage it assumes a plaster-like appearance, resembling lime broken down with a small quantity of water, and is of a milky whiteness, unless mixed with some foreign material, as with melanotic matter in the lungs, or in the bronchial glands. In the early stage, under the microscope, the interglobular material is preserved, but an increased proportion of saline and mineral granules are observed. By degrees, the amorphous stroma diminishes, and becomes completely replaced by the mineral particles, *which are sometimes deposited even in the interior of the tubercle corpuscle.* At the same time, the fatty matter is liable to increase, and groups of cholesterine crystals appear, which are much more frequent in cretaceous than in crude or softened tubercles.

The following is another account of the cretaceous transformation. Inflammatory plastic effusion, free from all tuberculous taint, takes place, in the first instance, in the adjacent parts. On the subsidence of the inflammation, the textures shrivel. This occurs in the lungs in a degree proportionate to the obliteration of the bronchial tubes. Ultimately, the tuberculous mass becomes surrounded simply with a thin isolating crust, and the absorption of the fluid parts of the tubercle gradually ensues, leaving at first a dryish pap-like residue; the organic elements of the tubercle appearing to be taken up by the system, and phosphate and carbonate of lime progressively deposited in their stead. Thus the original volume of the entire mass diminishes more or less rapidly;

and a considerable portion of the adjoining structure, as of the lungs, is at times reduced, by obliteration and shrivelling, to a hard shell, holding in its centre a chalky tubercle no larger than a pea. This healing process is said to be by no means infrequent; its traces are found in very aged, and occasionally in younger individuals.

Cretaceous tubercles are of extremely frequent occurrence. They are met with much less frequently in children than in adults, and much less generally diffused. The continental pathologists affirm that they are met with mostly in subjects who have been cured of old pulmonary affections of limited extent, in whom death has been produced by some other disease. They are found, also, in the subjects of extensive pulmonary disease terminating fatally; but, as remarked by Lebert, this does not invalidate their curative tendency. It shews a disposition to cure in certain parts; but the disease of the blood may continue its ravages in other parts, just as intestinal ulcers are sometimes found cicatrized in the autopsy of individuals who die of typhus, in whom there are many other ulcers not cicatrized. Cretaceous tubercles are found, especially in the lungs and bronchial glands, occasionally in the mesenteric glands, and even in the glands of the neck. Their connection with tuberculosis, and in particular with tuberculosis pulmonalis, has been long known. Cullen refers to cases in his own experience of calcareous concretions coughed up frequently with a little blood; sometimes with mucus only, sometimes with pus. In two cases, the symptoms of "phthisis" were never fully formed, and the patient entirely recovered.*

4. *The Cicatrization of Tuberculous Ulcers.*—Many observers, as for instance Albers, deny the possibility of the cicatrization of tuberculous cavities. They ascribe the cicatrices which have been so frequently found in the lungs to the obliteration of pulmonic non-tubercular abscesses; and the main argument employed is the infrequency with which tubercles are found in the vicinity of such cicatrices, either in the lungs or other organs. But we have admitted another explanation of this infrequency, viz., their absorption.

Rokitanski states, if I clearly understand his views, that, when tubercles tend towards cicatrization, the progress of the disease is

* First Lines. Vol. iv., p. 422.

slow, and a more healthy inflammation is set up around the tubercular mass or cavity. The result of this is a deposit of the gelatiniform tuberculous matter, which closes, and ultimately produces a wasting of the air-cells. This may form a persistent layer, and it may gradually become more albuminous or fibrinous, or it may be thrown off and replaced by tubercle, as the state of the patient's blood may happen to be more or less tuberculous, and as the disease tends towards cure or not,—this albuminous deposit being always indicative of a curative process, and sometimes proceeding to a complete cure.

The occurrence of cicatrization in tuberculous ulcers, even after they have committed great ravages, is now received by such high and competent authority, — Laennec, Louis, Andral, Carswell, Lebert, &c.,—that it can no longer be doubted. The tuberculous ulceration of the lymphatic glands heals. It is uncertain whether these ulcers cicatrize in the intestines,—Louis does not mention such a fact. Tuberculous caverns in the lungs occasionally heal. The mode in which healing takes place, making some allowance for difference of structure, is essentially the same in all. 1. There is a cessation of the deposition of tubercle in the neighbourhood of the ulcer. 2. The formation of a fibro-cellular membrane, which closes the ulcer. This membrane is at first very vascular, but becomes gradually less so, and ultimately contains no vessels at all (Lebert). 3. The membrane becomes transformed into a fibrinous production, with a more or less abundant fibrinous deposition on its surface and in its neighbourhood. 4. This structure follows the ordinary law of such tissues; that is to say, by the efflux of time, it gradually diminishes in volume, which gives it particular characters, as a contracted and puckered aspect, which is observed both in the neck and the lungs.

According to the tissue in which tuberculous ulcers thus cicatrize, different circumstances occur. In the lungs the membrane gradually thickens, most probably from behind, rather than from plastic effusion on its free surface; it is assimilated to the organism by replacing the pre-existing tuberculo-purulent false membrane. The cavity contracts, and the membrane grows, as it were, towards the centre, until it is completely filled with a cellulo-fibrinous substance like brawn, or the remaining cavity may remain open, simply losing the character of the original disease. The minute

circumstances attending these processes can only be properly considered when treating of the individual varieties of tuberculous disease.

F.—THE CHEMISTRY OF TUBERCLE.

1. *Microscopical Chemistry of Tubercle.*—The micro-chemistry of animal products, and of tubercle in particular, has been very superficially attended to at present, and practical and scientific medicine has derived but a very small share of those advantages which are to be expected from its cultivation. According to Vogel the *amorphous stroma* of tubercle resembles coagulated fibrine, and micro-chemically reacts like it, acetic acid and alkalies, rendering it pale and finally causing its disappearance. The *granules* differ among themselves in their chemical characters; those which appear to be modified protein compounds are insoluble in excess of acids, alkalies and æther; those which consist of fat dissolve in boiling æther; the calcareous salts dissolve in acids with partial effervescence. The *cells* with nuclei are partly soluble in acetic acid; those without nuclei are insoluble; and both disappear on the addition of caustic ammonia or potash; according to Lebert they are also dissolved by hydrochloric, nitric and sulphuric acids. Thus they differ essentially from pus globules which become transparent and constantly develope one or more nuclei with acetic acid. Simon states that the stroma constituting the greater part of the grey granulation is soluble in acetic acid and in the alkalies, but the abortive, misshapen and angular cells are insoluble.*

2. *Chemical Analysis of Tubercle.*—The analysis of the pathological products of tuberculosis is also, at present, very imperfect. the semi-transparent grey granulation does not appear to have been separately examined, nor have the contents or the walls of pulmonary caverns in their different stages, nor tuberculous cicatrices. A knowledge of the composition of the whole of these is essential to a complete state of chemical pathology of tuberculosis. The facts of science are nearly limited to the analysis of tubercle, using the word in a general sense, but applying more particularly to yellow tubercle in its ordinary crude, softened, and cretaceous states.

(a) THE RESULTS OF THE ANALYSIS OF CRUDE TUBERCLE.

(*a*) *Elementary Analysis.*—Some very interesting facts have

* Pathological Anatomy, translated by Dr. Day, p. 279.

been determined by Scherer relating to the ultimate composition of tubercle. On analysis of the crude tubercular matter of pulmonary tubercle, after the most careful removal of foreign constituents, the tubercle yielding little fat or extractive, and thereby appearing to shew that it was of recent formation, the following ultimate elements were obtained:—

Carbon	53·888	= 100
Hydrogen	7·112	
Nitrogen	17·237	
Oxygen	21·767	

This corresponds with the formula C_{43} H_{35} N_6 O_{13}; and hence, comparing it with Liebig's formula for protein, (C_{48} H_{36} N_6 O_{14},) it may be regarded as protein, from which 5 atoms of carbon, 1 of hydrogen, and 1 of oxygen have been removed.*

By comparative analyses, Scherer has also shown that a remarkably close correspondence exists in the ultimate composition of tubercle from whatever part of the body it is derived, hydrogen being the most variable element.

The crude animal matter of a scrofulous mass from the abdomen of a child who died from general tuberculosis, yielded on ultimate analysis, after extraction with water, alcohol, and æther,—

C_{46} H_{38} N_6 O_{12}

Hence, in this case, the isolated, crude scrofulous, or tubercular matter may be hypothetically regarded as formed from protein by the removal of 2 atoms of carbon, and 2 of oxygen, and the addition of 2 atoms of hydrogen; or, by making the carbon the standard, we have—

1 atom of crude animal matter (tubercle?) of a scrofulous mass . . . . . = Pr. + HO + 2H†

The following table exhibits the results of Scherer's analyses in juxta-position:—

Tubercle from the lung . .	C_{43}	H_{35}	N_6	O_{13}
,, ,, liver . .	C_{45}	H_{36}	N_6	O_{13}
,, ,, peritoneum .	C_{46}	H_{36}	N_6	O_{13}
,, ,, brain . .	C_{46}	H_{37}	N_6	O_{13}
,, ,, mesentery .	C_{46}	H_{38}	N_6	O_{12}

If we suppose protein to be the basis of tubercle, and proceed upon Liebig's formula, C_{48}, &c. The following are hypothetical

* Simon's Chemistry, Sydenham Edition, by Dr. Day, p. 479.

† Idem, 481.

formulæ, which the above results afford for the several varieties of crude tubercle:—

2 atoms of tubercular matter from the lungs . $= 2\,Pr. + NH_3 + 2\,HO + H.$
2 atoms of tubercular matter from the liver . . $= 2\,Pr. + NH_3 + H.$
2 atoms of tubercular matter from the peritoneum . $= 2\,Pr. + NH_3.$
4 atoms of cerebral tubercle . . . . $= 4\,Pr. + NH_3 + 4\,HO + 3\,H.$

We have also the following elementary analyses of tubercle by Dr. Glover:—

——	Carbon.	Hydrogen.	Nitrogen.	Oxygen.	—
Crude completely degenerate tubercle from the mesentery of a phthisical subject	54·97	6·63	12·31	26·09	=100
Crude mesenteric tubercle from a phthisical subject	56·40	.....	15·56	.....	
Crude lung tubercle	53·43	6·64	14·02	25·91	=100
Organized lymph from the pleura of a phthisical subject	57·18	.....	15·05	.....	
Ditto from the liver of a tuberculous subject by Scherer	55·19	7·186	16·602	21·022	=100

There is a remarkable correspondence in Scherer's results, and I am disposed to think them highly important; but, in the present state of science, it is very difficult to determine whether the radical defect consists in an excess of nitrogenous and hydrogenous particles, or a deficiency of carbonaceous materials. There is a want, also, of elementary analyses of tuberculous blood; and we are unable to say whether any modification of the elementary constitution of the blood corresponding with the tuberculous modification of its products, does or does not exist; all we can at present affirm is, that from the proximate analyses of the blood in incipient phthisis and scrofula, and from *à priori* reasoning, it is fair to presume that such a modification would be detected by accurate experiments. The results of these elementary analyses must not be overlooked in treating of the essential nature or the theory of the disease.

(*b*) *Proximate Analysis.*—Thénard was the first person who attempted the proximate analysis of crude tubercle; his experiments were performed in the infancy of organic chemistry; and the following are his quantitative results:—

Animal matter	98·15
Muriate of soda, Phosphate of lime, Carbonate of lime	1·85
Iron	traces
	100·0

Since Thénard's time organic analysis has greatly advanced, and numerous experiments on tubercle have been made by different chemists according to the most improved methods.

Scherer has given one of the best analyses of a mass of tubercle deposited in the liver. It was composed of round, irregular nucleated cells, larger than pus corpuscles, and numerous interspersed granules. He separated the fatty matter, water extract, alcoholic extract and salts; and the crude tubercular matter is to be understood as having the elementary constitution given above. The following are the properties of the constituent parts:—

Water		826·04
Solid residue:—		
Fat taken up by æther, consisting of olein and margarin	18·63	
Alcohol extract	21·75	
Water extract, with very slight traces of pyine	8·34	
Fixed salts	4·90	
Crude tubercular matter	120·34	
		173·96
		1000·00

The most complete chemical analysis of crude tubercular pulmonary substance which I have met with is made by Preuss, and quoted by several of the recent writers; in order to exhibit it in the clearest point of view to the reader, I have calculated it in the proportions of a thousand parts:—

Water		799·50
Residue of the pulmonary tissue composed of—		
Gelatine obtained by boiling	13·497	
Substances furnishing no more gelatine	49·106	
Fatty matter	2·697	
		65·30
Tubercular matter containing—		
A. Substances soluble in boiling alcohol—		
1. Cholesterine	6·685	
B. Substances soluble in cold alcohol and in water—		
2. Oleate of soda	18·269	
3. Chloride of sodium 4. Lactate of soda 5. Sulphate of soda 6. An indeterminate substance	11·448	
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 water and in alcohol—		
11. Casein altered by the heat 12. Oxide of iron . . . 13. Phosphate of lime . . 14. Carbonate of lime . . 15. Magnesia . . . 16. Soda	. . . . .	88·108
		135·20
		1000·00

Legendre gives the analysis of 100 parts of crude encysted tubercle from the brain of a child. It was deprived of its humidity and reduced thereby to one third of its original bulk.*

Albumen soluble in water	15·25 =	5·08
Cholesterine	43·15 =	14·38
Gelatine	·75 =	·25
Sub-phosphate of lime	2·25 =	·75
Fatty matter	5·10 =	1·70
Membrane and coagulated albumen . . .	33·20 =	11·07
Coss	·30 =	·1
		33·33
Water two thirds . . .		66·67
	100·00	100·00

As compared with the healthy constitution of the brain here is an immense increase of cholesterine and albumen, and a diminution of fatty matter.

In tubercle from the horse, J. F. Simon detected the following constituents:—The tubercular matter was deposited in masses from the size of a nut to that of a pigeon's egg; it varied from a yellow to a flesh colour, and its consistence was such as to admit of its ready division by the knife. Internally it was green and resembled coagulated casein.

Water	84·27
Fat containing cholesterine . . .	1·40
Spirit extract, with salts	1·52
Caseous matter of Preuss . . .	1·14
Water extract and salts . . .	3·80
Insoluble constituents	4·44 †

Other proximate analyses of tubercle are extant too numerous to be inserted, and the opinions of the best organic chemists

* Legrand d' L'analogie et des Differences entre les Tubercles et les Scrofules, p. 152.

† Anim. Chem. Syd. Ed., vol. ii., p. 478.

respecting the composition of this morbid production have varied greatly. Langlois and Huenefeld regard it as consisting essentially of fibrine; Prout as incipient albumen; Gendrin as a mixture of albumen and salts. What Preuss and some other chemists have set down as casein, Glover and others have regarded as pyine; according to Mulder a tritoxyde of protein. That we may have the results as fully displayed as our limits will allow, for future reference I insert the following abstract:—

There was found by—

Lassainge.—In *tubercles from the lungs of a horse:* Animal matter, 40 parts; subphosphate of lime, 35; carbonate of lime, 9; salts soluble in water, 16=100. In *tubercles from the liver of a horse*; Animal matter, 50; subphosphate of lime, 45; carbonate of lime, 4; salts soluble in water, 1=100.

Hecht.—In *crude tubercle:* Fibrine, 30 parts; albumen 23; gelatine 27; water and loss, 27=107.

F. Boudet.—In *tubercle:* Casein, gelatine, and a considerable quantity of cholesterine. Treated with cold water, it yielded albumen, a substance resembling casein, and a fibrinous residue; with alcohol, oleic and margaric acid, lactic acid, neutral fat, cerebric acid, cholesterine, lactate of soda, and extractives. The ash of crude tubercle furnished products analogous to the calcareous concretions in the lungs and bronchial glands, viz., phosphate of lime, carbonate of lime in small quantity, carbonate and sulphate of soda, iron and silica. This latter statement, if to be depended upon, is highly important.

Güterbock.—In *tubercle from the bronchial and jugular glands:* A substance peculiar to tubercle, which has not been verified by other chemists; pyine, also phymatine, albumen, and fat.

Scharlau.—Albumen, gelatine, fibrine, fat, water.

Vogel.—Besides combinations of protein (fibrine, albumen, and casein,) fat, extractives, a material analogous to pyine and various salts.

Dr. Glover.—In *mesenteric tubercle:* Pyine, muco-extractive, and a peculiar extract. In another specimen: Fats, extractive matter, chlorides, phosphates, alkaline salts; protein residue 20 per cent. In *pulmonary tubercle:* Pyine, albumen, (but no casein,) fats, and extractives. In *fresh tuberculated bronchial glands:* Fat, acids, cholesterine, extractives, insoluble protein, salts.

(b) RESULTS OF THE ANALYSIS OF SOFTENED TUBERCLE.

The chemical changes in the process of softening are at present but very little understood. L'Heretier found softened tubercle composed of albumen, very soft fibrine, fatty matter, and carbonate of lime. Boudet affirms, that the tuberculous material becomes alkaline, and soluble in the alkali developed. Lehmann appears to have ascertained that the combinations of protein (albumen, fibrine, and casein) gradually lose their sulphur and phosphorus, which totally disappear. Several authorities affirm, that, as softening progresses, the tubercle contains more and more fatty matter.

Mr. Wood found the following constituents in softened tubercle:

1.	Substances soluble in ether	3·18
2.	„ „ in cold alcohol, and not in water	9·29
3.	„ „ in cold alcohol, and in water	10·66
4.	„ „ in water, and not in alcohol	3·14
5.	„ insoluble in ether, in alcohol, and in water	67·78

Lehmann found in a grey tubercular mass well dried only 3·54 parts of fat in 100, although almost every other tissue contains a much larger proportion.*

(c) RESULTS OF THE ANALYSES OF CRETACEOUS OR HARDENED TUBERCLE.

The earliest analysis made was by Thénard and Lombard, who found in 100 parts—

Animal matter	3 parts
Saline or earthy matter	96 parts

L'Heretier found cretaceous tubercle composed of—

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

In a calcareous concretion from a bronchial tube, in a case of phthisis, the concretion being invested, and, according to the chemical re-action, pervaded by membranous substance, Scherer found—

Organic matter	20·10
Phosphate of lime	69·92
Carbonate of lime	9·09
Chlorate of sodium, phosphate and sulphate of soda	0·89
	100·00

Scherer also found in a chalky concretion from the pleura—

Organic substances	36·967
Phosphate of lime	55·924
Carbonate of lime	7·109

* Lib. Cit., p. 268.

Dr. Glover quotes from Simon's "Beiträge," the analysis of a bony concretion from lungs which contained many calcareous concretions. The proportion of incinerated salts was 61·11 to 38·89 organic matter, and 100 parts of the salts were composed as follow :—

Earthy phosphate	87·2
Carbonate of lime	11·5
Soluble salts	00·65
	100·0

Dr. Glover found, in a tubercle partially cretaceous, 24·80 of animal matter, and 9·00 salts; the salts were as follow :—

Chlorides, with a trace of alkaline salts . .	1·22
Salts soluble in water	1·90
Phosphate of lime	5·40
Carbonate of lime, a trace and loss . . .	0·48
	9·00

Dr. Glover also found in lung concretions, dried animal matter, 07·7; incinerated salts, 22·4, composed thus :—

Phosphate of lime	16 45
Carbonate of lime	5·10
Sol. salts and loss	0·85
	22·40 *

Lehmann states that chalky concretions often contain cholesterine.

Mr. Henry found, among various pulmonary tubercles—*A.* A few composed chiefly of carbonate and a few of phosphate of lime. *B.* A few of carbonate and phosphate of lime, with much ammonio-magnesian phosphate. *C.* A few of carbonate of lime, with ammonio-magnesian phosphate, and much phosphate of lime. *D.* (In a tubercular bronchial gland), phosphate of lime, carbonate of lime, and animal matter.

There are two interesting points in these analyses: the approximative uniformity of the results, and the analogy in composition of these concretions to bone and bone earth. It is necessary to state, that F. Boudet gives different results. He found 701 parts of soluble salts and 295 of residue; the salts consisted of chloride of sodium, phosphate of soda, and sulphate of soda, and the residue of phosphate of lime, carbonate of lime, silica, and a small quantity of oxyde of iron; but this differs so widely from all the other analyses in the proportion of soluble saline matter, that it is

* Glover on Scrofula, 1846, p. 67.

generally discredited. In general, the harder the tubercle, the larger the quantity of earthy salts.

The history of tubercle contains indubitable proof that this anatomical element of disease is a substance *sui generis*. Its physical, microscopical, and chemical characters show that it differs from every educt or product of nutrition or healthy secretion or excretion, and from all the educts or products, structural or amorphous, of ordinary inflammation. It differs from every other morbid product, non-malignant, malignant, or parasitical. It is essentially neither serum, pus, coagulable lymph, albumen, fibrine, nor any particular texture. At the same time, it is manifestly derived from the blood in an unhealthy condition, and the characters of the product and those of the morbid blood have certain relations which indicate very satisfactorily that the one depends upon the other. The morbid liquor sanguinis, and the deficient and perhaps structurally defective red corpuscles of the blood, are the analogues of the amorphous stroma and defective cells of tubercle; the vitiated albuminous constituent of the plasma is probably the analogue of the caseous constituent of tubercle and even of tuberculous and scrofulous pus; the low vitality of the blood indicated in my diagram (p. 15) is the analogue of the comparatively inorganic quality of the tubercular product and of the very low degree of organization which it presents. Organic chemistry has taught us thus much; it remains for new researches to develope the essential character both of the morbid condition of the blood and of its product—the liquor tuberculi; the discovery of the one will necessarily comprise that of the other. When treating of the general pathology or theory of the disease, the views which have been entertained of its nature will come under consideration. In the mean time the analyses recorded suggest a few remarks, but the anatomico-pathological facts connected with the diseased state of the blood and the deposit of tubercle, require to be detailed, since no theory can prove satisfactory which is not consistent with these facts.

As respects the chemistry. In the first place, although variable, there is a much nearer approach to uniformity in the results than might have been expected. We have to bear in mind the variable circumstances under which tubercle is deposited in the tissues, and collected by the chemist for examination. Its composition un-

doubtedly varies according to the length of time it has been deposited and the stage of its development. If we were to admit that it is a definite chemical compound, which is very probable, but by no means proved, and is perhaps incapable of proof or disproof, still this compound must be subject to changes and to admixture with numerous materials, as with those composing the tissues, which, by pressure and otherwise, become disintegrated and blended with the essential constituents of tubercle, or with the products of inflammation, as pus or lymph, from inflammation of the parenchymatous structure of an organ, or with mucus and pus from the mucous membranes, or with blood itself. It is always difficult, and frequently impossible, for the chemist to separate these different products, or to estimate their proportions. Tubercle must also, from the same causes, exhibit differences according to the nature of the tissue in which it is deposited.

Chemical analysis leaves no doubt that tubercle contains a protein compound as an essential constituent, which appears to bear a close analogy to, if it be not identically, casein. This fact is confirmatory, if not demonstrative, of the view taken throughout these observations, that it is a secretion from the blood, for all the facts of science contradict the notion, that protein compounds are formed in any of the animal tissues, or are derived by those tissues from any other source than the blood. The caseous quality of tubercle and scrofulous pus indicates the presence of a nitrogenous compound of a caseous nature in the liquor tuberculi, showing that from the liquor sanguinis of tuberculous blood a caseous blastema is exuded, differing from the ordinary healthy blastema. Its caseous quality renders it unfit to nourish the tissues, and gives it a tendency to solidification.

The existence of pyine, regarded as a tritoxyde of protein, detected in particular specimens by various chemists, does not, in my mind, invalidate that of casein. It is manifestly by no means a constant constituent. The question will at once arise, whether a peculiar substance may not be the result of inflammatory action on tuberculous blood resulting in the superoxidation of the protein compounds. In this point of view, pyine would be regarded as an inflammatory product superadded to the essential constituent of tubercle; but the chemistry of the phases and complications of tuberculous development is at present so imperfect, that it is scarcely safe to venture even a conjecture upon such a point.

One of the most interesting facts in connexion with the chemistry of tubercle, is the existence of a large proportion of fatty matter. This is the result of a majority of the analyses, and Rokitanski, Gulliver, and Scherer affirm, that this constituent increases from the time that tubercle loses its transparency and as the softening process proceeds; but it is important to remark, that the fatty principle is chiefly cholesterine and not true fat, and in this especially tubercle differs from plastic and organizable exudation, which always contains true fat.

A most curious fact also was discovered by M. Guillot, which, if corroborated, might ultimately assist us in arriving at a knowledge of the essential nature of tuberculosis. M. Guillot has ascertained experimentally, that the dried parenchyma of those portions of the lung which in phthisis, as also in pneumonia, have become impermeable to the air, contains a very large proportion of fat. In phthisis as much as 40 and even 52 per cent. of fat is said to have been detected in the desiccated tissue of the diseased part of the lung. It further appears, that the proportion of fat in the dried parenchyma of the fœtal lung is diminished after respiration becomes established, from the proportion of 10 or 18 per cent. to 6 per cent., and that in all diseases wherein a portion of lung loses its functional powers, an accumulation of fat takes place in that portion.

Two explanations have been suggested of this increase of fatty matter in tuberculous or non-respirable lung. It has been held, that the materials of respiration being to a certain extent converted into fatty matter in the blood, preparatory to eremacausis, and this eremacausis taking place in part during the passage of the blood through the lungs, that an accumulation of fat takes place in consequence of the lung having ceased to perform its function. It has on the other hand been held, that tubercular matter is essentially composed of a large proportion of fat. According to the latter view, the nature of tuberculosis is diametrically opposite to that suggested by some authors, it is a fatty degeneration.* These facts have to be associated with the frequency of a fatty condition of the liver in tuberculosis, as observed by Louis and others, although other results were obtained by the experiments of Regnaud; and with the effects of cod-liver oil in the treatment of tuberculosis. The whole must be comprised in the con-

* Compt. Rendues. Juin. 12, 1847, Academy of Sciences.

sideration of the essential nature and theory of the disease. The excess of fatty matter in tubercle is taken by Dr. Madden to imply a retrograde morphology, and this accords with the views of Dr. Addison, to which I have already adverted.

Tubercle appears also to contain a great excess of extractives, and, as compared with other proteiniform products, an excess of water. These and its other qualities associate the tubercular deposit with the vitiated state of the liquor sanguinis, which I formerly described as an essential character of tuberculous blood.

The analysis of cretaceous masses is one of the most interesting, not to say important, parts of the subject. The uniformity of the results, and the analogy to bone-earth and bone will strike every one. Moreover, it appears that after the process of softening, if the tendency of the constitutional and local affection is to quiescence and health, and even before softening, if that tendency exist, the aqueous parts of tubercle must be absorbed. Where this tendency to health and restoration occurs, the analyses also prove another most important fact; the crude tubercular matter which, in its original state, is probably incapable of resorption, must undergo transformations by which it is rendered susceptible of that process. In order to admit this it is only necessary to consider the large proportion of earthy material which remains in cretaceous tubercles, if these cretaceous masses be justly regarded as the remains of tuberculization. The quantity of earthy matter aggregated in these masses is a most significant fact. Crude tubercle contains but a very small proportion of earthy salts—say one per cent.—whereas these masses frequently weigh ten, twenty, and thirty grains. The deposition and resorption of animal matter, leaving earthy particles behind, must have taken place to a very great extent, or for a very considerable period. It appears to me, that where the tendency to cretaceous aggregation has existed in the highest degree, the blood must have wholly or partially lost its tuberculous quality; and that, after having secreted intractable tubercle, owing to this favourable change it pours out a blastema, which, depositing its earthy salts, is in the main susceptible of resorption, and is actually absorbed, the earthy particles gradually accumulating in the tubercular cavity. That some such process as this occurs follows from a consideration of the whole series of chemical facts.

The ultimate analyses and their reduction into formulæ have

been regarded by some rather as matter of amusement than of utility. I cannot adopt that view. Whatever the defects of organic chemistry at the present moment, I believe it is gradually elevating medicine into a demonstrative science; and I think it is incumbent on us to regard discovered facts in every point of view. Scherer finds, in one point of view, an excess of carbon and hydrogen in tubercle from the liver as compared with that from the lung; aud he thinks this may arise from the deposit in the lung being more exposed to the air. Dr. Glover's analyses give to the protein compound of tubercle a smaller per centage of azote in general than those of Scherer.

In concluding the physical and chemical history of tubercle it remains to remark, that there has been much controversy upon the question of its vascularity or non-vascularity. From the description here given, I think it must be perfectly clear, that tubercular deposits are not essentially vascular. Although vessels may frequently be detected in them, and tuberculated structure and even tubercle may sometimes be artificially injected, the vessels always belong to the original tissue, and not to the deposit. Tuberculated structures are frequently vascular, in this sense, in their earlier stages, but the vessels become obliterated in the progress of the tubercular development. Tubercle is sometimes deposited, more especially around the capillary vessels, which are only ulteriorly destroyed by compression. They are never supplied with lymphatics.

The question, whether tubercle is to be regarded as an organic or inorganic substance, has in like manner been the subject of almost interminable controversy. This question appears to me to be reducible to a very narrow point. Tubercle, regarded in the mass, is unquestionably inorganic. Regarded in its microscopic and chemical detail, we have seen, not only that it contains organic materials, but that a portion at least of these materials give unequivocal evidence of organization. However imperfect the tubercle cell, if its existence be admitted at all as a constituent of tubercle, its cellular form is irrefragable proof of the operation of the living principle. The question is, therefore, narrowed to this—whether the cells detected in tubercle are to be regarded as essential constituents, or as the rudimentary or effete remains of the tissues in which tubercle is developed. Dr. Addison appears to take the latter view; he regards tubercle as being composed essen-

tially of retrograde or abnormal epithelial cells. Reviewing the whole of the facts, my own leaning is in favour of the former view —that the tuberculous blastema from tuberculous blood is frequently sufficiently vitalized to admit of the formation of imperfect cells. In this point of view, tubercle presents various gradations of organization, from a substance containing numerous imperfect organic cells to one with no trace whatever of organic structure. In any case, when tuberculous matter becomes aggregated so as to be recognized as tubercle, organic growth by intussusception and the construction of tissues from cells soon cease to be possible, but in the earlier stages the morbid blastema is susceptible of imperfect cell-growth.

SECTION IV.

MELANOTIC MATTER.

Bayle described melanosis of the lung consisting of ulcers of various sizes, as black as coal, and very hard, sometimes a few lines thick, and at others as many inches, the parts remote from the ulceration being sound; or, if the whole lung is affected, it becomes hard, compact, black as charcoal, and sometimes like half-burnt leather; he made this a distinct species of phthisis, but states that he found it frequently complicated with other species of this disease, and gives cases of tubercle combined with melanosis.

Laennec noticed the occurrence of "black pulmonary matter" with the development of tubercles in the lungs, and more especially with the cicatrization of tubercular cavities, the quantity being sometimes very great and mixed with cartilaginous deposits and cretaceous formations, but he makes a distinction between this black matter and true melanosis. He admitted that it is sometimes difficult to distinguish between these two kinds of black matter, and many pathologists, among whom M. Andral may be mentioned, have subsequently questioned or denied the distinction.

Melanotic matter occurs in masses or distinct tumours, encysted or not; it occurs also infiltrated in the substance of tissues, or in layers on their surface, or as a black fluid, and may be developed either in healthy or unhealthy organs or tissues, and is very frequently combined with the morbid products of different diseases—as cancer and tubercle.

It has been regarded—1. As an adventitious product, like cancer or tubercle, having regular periods of crudity and softening; this

view was taken by Bayle, Laennec, Trousseau, Leblanc, and others, but has been abandoned on grounds advanced chiefly by M. Andral. 2. Simply as a special secretion from blood in a morbid condition. 3. As an aberration of the black pigment of the body, or a predominence and vicarious deposit of the carbon destined to furnish the colouring matter of hair, skin, uvea, &c. 4. As a modification of the colouring matter and fibrine of blood stagnated in the vessels or deposited in the tissues. 5. As an extraneous carbonaceous matter introduced from without. In the actual state of science these different views cannot be wholly discarded from consideration in the history of tubercle.

Having regard to the various probable sources of black matter in the animal structures, and to certain very obvious differences in the history of melanotic productions as they present themselves to the observer, pathologists have very generally admitted the existence of a *true* and a *spurious* melanosis.

Chemical and microscopical research have at present by no means clearly elucidated the different forms and varieties of melanotic matter. According to the analysis of Breschet and others, it contains a large proportion of carbon and may be regarded as the colouring matter of blood, fibrine and albumen, in a modified state, and phosphate of lime and other salts of the blood, with three distinct fatty matters. Other analyses have not furnished fatty matter, and Andral enquires whether this fat belongs to the melanotic matter or whether it is derived from the tissue of the organ in which it is developed. The above mentioned fatty matters are most likely ordinary fat altered by the chemical processes.

The microscope shews that melanotic matter generally consists of a pathological epigenesis of granular pigment molecules, 0·0008 of a line in diameter, occasionally contained in spherical cells, 0·015 of a line in diameter or smaller, but for the most part deposited free in the tissue or parenchyma, or disposed in dense, irregular heaps in the areolar tissue. This is the true melanosis of Vogel, who states that these molecules are not pure carbon, but contain a large proportion of that element (p. 196). This author also describes pseudo-melanosis as pigment produced from a change in the colouring matter of decomposed blood, owing to chemical causes; and more particularly, a black or bluish pigment, consisting of an aggregation of black granules of indefinite form, and varying in size up to the 100th of a line in diameter,

resulting from the formation of a sulphuret of iron, produced during the decomposition of blood; the granules sometimes occur singly, sometimes collected together in larger or smaller masses, and occasionally enclosed in cells. Black granules of sulphuret of iron sometimes occur between the brown patches of altered and coagulated blood.

The melanosis which occurs in tubercular structures is the spurious form, or that which depends upon the accumulation of black matter from without, the action of chemical agents, or the stagnation of the blood (Cyc. Prac. Med., vol. iii., p. 86). Some pathologists still think that it may result either from the introduction of extraneous matter, or the action on the blood of a chemical agent respired; but it is at present most generally regarded as modified tuberculous blood, in the first instance stagnating in the vessels, and then extravasated—modified blood-clot, the serum and salts of which having been absorbed, it passes through all the shades from deep red to slate grey or perfect black. It sometimes surrounds tubercles as a dark ring, obscuring them more or less; or a multitude of minute vessels filled with dark blood, either grouped closely together or having a stellate or ramiform appearance, occurs. It may be infiltrated and diffused or circumscribed; a membrane may appear as if spotted with a dark brownish or black pigment, or the various structures of a part may appear as if transformed into a slaty-black tissue. It is most common in old persons.

Melanotic matter is also frequently combined with tubercle, in which case it does not give a uniform tinge, but generally appears in isolated points or striæ. It occurs almost constantly, and to a great extent, where tubercles exhibit the curative tendency already described; as in the parts adjoining calcareous tubercles and cicatrized cavities and in entire masses of indurated structure. The chalk-like residue may be combined with it, giving it a slate-grey or bluish-black tinge. Andral once found in a person who died of phthisis several pulmonary calculi speckled with a multitude of small black points. It occurs both in the unsoftened portion and in the softened pap-like mass, which it combines with, sometimes rendering it a uniform black pulp which may retain its softness for years, instances of which occur in the bronchial glands, and sometimes distinct calcareous nuclei occur in the midst of the blackened mass.

Melanotic matter occurs in tuberculous subjects in various sites, as the lungs, the bronchial glands, and the peritoneum; also in tuberculous false membranes of the pleuræ and peritoneum, and in the lungs. Andral sometimes found it consisting of the false membrane mixed with colouring matter derived from the blood. He considers it in all instances the result of chronic inflammation —a state of induration with a black tint; he remarks that in old men chronic pneumonia is most frequently accompanied with it— whereas when tubercular mischief has been repaired in young subjects this black pigment is often absent—"as if the disposition to the formation of tubercles, so marked in youth, was subsequently replaced by a disposition to the secretion of melanotic matter." Carswell also found it mixed with calcareous matter in the bronchial glands in persons advancing in years in whom bronchial phthisis had manifestly existed for a long time. But the occurrence of melanotic matter in tuberculated structures is not absolutely limited to advanced age. Andral found it in a girl aged nine years.

The notion that the deposit of melanotic matter in tubercular subjects is essentially connected with inflammation has no better foundation than that the deposit of tubercle is necessarily dependent upon that process. The tendency to melanotic deposit depends primarily upon the condition of the blood, and secondarily upon local circumstances; hence, in tuberculosis pulmonalis it appears to be intimately connected with the disturbance of the respiratory function. The facts before us lead to the conclusion that a particular modification of the blood tending to melanotic deposit is unfavourable to the continuance of a tuberculous state of the blood, and accordingly checks the progress of local tuberculization, but the subject is still open to rigid scientific enquiry.

The softening frequently observed in the melanotic matters of tubercularized structures is attributable to the softening of the tubercle with which it is mixed, or to the ulceration or liquefaction of the surrounding tissues.

The occurrence of melanotic matter in particular structures when the blood is in a tuberculous state, probably depends upon different causes, and the black matter, as it is met with in different parts of the body and under various circumstances, probably differs in its nature. The details of this subject belong to the chapter on the special pathology of tuberculosis.

CHAPTER IV.

THE SPECIAL PATHOLOGICAL ANATOMY OF TUBERCULOSIS.

When it is considered that the blood of a very large proportion of the human race is more or less affected with the tuberculous taint, and that tuberculous subjects are exposed, equally with the robust and healthy, to the exciting causes of all those disturbances of the physiological state which induce the anatomical changes constituting the fatal diseases by which the life of man is cut short, it will be readily understood that its morbid anatomy might be made to comprise the whole anatomical catalogue. Accurate observation would no doubt show that most of the pathological products of disease are more or less influenced by the tuberculous state of the blood. Without extending their researches thus far, morbid anatomists have ascertained, not only the fact of the deposition of tubercle in the organs and tissues as a peculiar morbid element in the tuberculous subject, but the occurrence of other pathological conditions; and the positive increased frequency of various anatomical changes in connexion with this disease of the blood, and of the particular forms and varieties which it presents. No part of scientific medicine perhaps does higher honour to the profession than the genius displayed, and the depth of research and accuracy of observation exhibited, in the minute investigation of the characters and specialities of morbid structure in this disease, as shown in the works of Portal, Bayle, Baillie, Laennec, Andral, Carswell, Louis, Hasse, Rokitanski, Lebert, Legrand, and other pathologists. It will be impossible to give anything approaching to a complete account of these labours, nor will it be necessary to embrace the extreme minutiæ, but I shall state succinctly the more important pathological appearances which have been described as occurring in the various stages and degrees of the disease, so as to convey a tolerably accurate notion of the nature and extent of the deterioration and disorganization of structure to which its subjects are more or less liable. Tuberculosis, as a disease of the blood, can only be thoroughly understood by giving

attention to its special pathology, and no theory of the disease can be admitted which is not consistent with the facts developed by *post mortem* investigations.

SECTION I.

PATHOLOGICAL ANATOMY OF THE DERMA AND OF THE SUBDERMOID TISSUES IN TUBERCULOSIS.

As already stated, in the earlier stages and slighter degrees of a tuberculous state of the blood, particularly while the individual continues in comparative health, and the affection of the blood and tissues can be regarded only as a predisposition to disease, tuberculous individuals are extremely subject to cutaneous affections. These affections are usually designated as scrofulous, and occur most frequently in children, or at that period of life in which the blood, although affected with the tuberculous taint, may not be matured for the deposit of tubercle, and when the skin is most susceptible of diseased action. They are produced by various exciting causes, and especially by the absorption of crudities from the alimentary canal. Similar diseases are produced from similar causes in healthy persons, but they run a different course. Scrofulous eruptions of the skin are essentially chronic and sub-inflammatory, and they have a suppurative and ulcerative tendency. They indicate a vitiated state of the dermoid blastema, corresponding with the low vitality of the blood and the defective cell-growth of the tuberculous predisposition, and they are cured by those remedies which are most efficacious in restoring the blood to its healthy standard. It is in these respects that they are scrofulous, and constitute a part of the special pathology of tuberculosis. The system is rarely affected secondarily by these eruptions, but they frequently occur simultaneously with other local affections to which the tuberculous habit is also liable. They generally subside, particularly under judicious management; and there is reason to believe, that, with other external local manifestations of tuberculosis, they sometimes have a beneficial tendency as respects the state of the blood, since it frequently happens in tuberculous families, that those children who pass through the external local affections escape the deposition of tubercle throughout life.

Cutaneous affections.—Lebert found skin diseases in tuberculous subjects most frequent from five to fifteen years of age, and very

rare after twenty. In 614 cases of scrofula the skin was affected in 116 cases, as follows :—

	CASES.
Impetigo	42
Eczema	23
Lupus	20
Eczema impetiginoides	11
Numerous furuncles with eczema and impetigo, two cases each	4
Herpes, acne, eczema, ecthyma, erythema, psoriasis, pityriasis, lichen, one case of each	8
Several affections in the same individual:—	
Herpes, eczema, urticaria and ecthyma	1
Impetigo and ecthyma	1
Impetigo, lichen and psoriasis	1
Eczema, ecthyma, and keloid tumours	1
Erysipelatous diathesis	1
Elephantiasis and eczema	1
Pemphigus, eczema and herpes	1
Herpes and pityriasis	1
	116

Thus, by far the greater number of these cutaneous diseases consist of suppurative inflammation of the derma. They occur much more frequently in the head and face than elsewhere; of the 116 cases 83 were in the head and face, 8 on the head and face, and also on other parts of the body, and 25 on the trunk and limbs. Their duration was from 3 months to 5, 6 and even 10 or 11 years. The table shews that exudative or suppurative inflammations are the most frequent. Hypertrophy with or without ulceration is the next in the order of frequency.

Of the 116 cases 24 were affected with tubercles in the glands or in the internal organs.

Independently of the complication with a deposit of tubercle, affections of the skin are rarely the sole local manifestation of a tuberculous state of the blood in scrofula. Of the 116 cases, 104 were complicated as follows :—

	CASES.
Simple complications with diseases of the eyes	42
,, ,, diseases of the bones	12
,, ,, swelled glands	9
,, ,, otorrhœa	5
,, ,, ulcers and abscesses	4
,, ,, white swellings	1
Double complications with ulcers, caries, ophthalmia, white swellings, simple glandular swellings, otorrhœa	17
Carried	90

	CASES.
Brought up . .	90
Triple complications with the preceding affections combined in threes	6
Quadruple complications—ophthalmia, ulcers, white swellings, caries	1
Divers complications	7
	104

The statistics of our own hospitals would probably give results differing somewhat from the above, but reflecting upon my own experience during twelve years of dispensary practice, and a long series of years of general practice among the poor in this country, I do not think they would vary greatly.

These statistics establish the important fact, that the association of internal tubercular deposit with the external development of scrofula is by no means so infrequent as hitherto taught. Of the 92 cases in which, at the time of observation, there was no manifestation of tubercle, it is impossible to determine how many may have subsequently developed tubercle in the lungs or other organs.

Abscesses.—The subcutaneous areolar tissue and the deeper layers of the cutis, besides the evidences of defective cell-growth already adverted to, are also especially liable, in a tuberculous state of the blood, to chronic inflammatory affections; hence the frequency of abscesses, ulcers, and fistulæ on the external surface. The tuberculous character of these affections is in general sufficiently well marked. In the formation of abscesses, the redness, tension, pain, swelling, and heat, are comparatively insignificant; there is especially an absence of the phlegmonous hue; they are less circumscribed, and when a pyogenic membrane forms, the abscess fills with pus having more or less the characters of tuberculous pus. Such abscesses degenerate into ulcers possessing peculiar characters.

Small tuberculous abscesses are liable to form on the face and other parts. They somewhat resemble lupus, but differ in being remarkably soft from the commencement; the pus they contain is sanious or sero-purulent, and it will sometimes be absorbed, leaving the skin of a violet tint. Subcutaneous abscesses are sometimes disseminated over a limb or on the trunk, either immediately below the derma or more deeply seated; they are circumscribed by condensed areolar tissue, and frequently remain for a long time indolent; inflammation of the skin developing itself very slowly.

The *abcès froid* of the French writers is a large chronic abscess, common in scrofulous subjects, sometimes forming rapidly, sometimes slowly, in the areolar tissue surrounding and connecting the muscles either above or below the fasciæ. They contain the seropurulent fluid and curdy flakes characteristic of the tuberculous condition of the blood, and occasionally thin pus. Sloughing of the areolar tissue is a very common occurrence; the dead tissue passing away in masses with the discharge, sometimes plugging up the orifice. These abscesses sometimes occur in connection with diseased bone, when the state of the blood has only attained that degree of tuberculosis which corresponds with the development of scrofula; hence they are not the result of the previous deposition and the softening of tubercle. They are generally of a low temperature. The fluid they contain is sometimes remarkable for a very distinct separation of the serous part from the pus globules, so that on opening the abscess a limpid fluid, as from a serous cyst, first exudes; and it is not until this fluid is evacuated, or until the abscess is compressed, that the grumous pus corpuscles present themselves.*

When pus is allowed to accumulate in tuberculous abscesses without any outlet, its elements sometimes react upon themselves, and gaseous products are the result, consisting of ammonia, hydrosulphuric acid or hydrosulphuret of ammonia.

The erythematous inflammation of the skin designated *chilblains* is very common in tuberculous constitutions. The symptoms of chilblains, and the effects of remedies upon them, well illustrate the state of the capillary circulation in such constitutions. From the action of cold, the vessels in the part affected are distended and congested with tuberculous blood, the crimson colour of the inflamed skin is suffused with blue, and the itching illustrates the acuteness of sensibility; the ulcerative tendency is constant; moderate astringents and stimulants afford relief, but the agency of a high temperature, as by holding the affected part before a fire, produces a still more distended state of the already distended capillaries, by which their vital powers are still further depressed, and the part is rendered more susceptible of the action of cold. This inflammation occurs in the soundest constitutions; as for instance on the nose and ears when long exposed to severe frost;

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* Lebert, lib. cit., p. 286.

but it is by no means so easily excited; requiring a far greater intensity of the exciting cause.

Ulcers.—Tuberculous ulcers, whether proceeding from the deposit of tubercle, from scrofulous abscesses, or from deeply seated affections of the tissues, possess peculiar characters which are highly significant of the qualities attributed to tuberculous blood, and of the irregular and defective nutrition of tuberculous subjects. Their margins are irregular, smooth, obtuse, loose and over-lapping; their base in unequal, mammillated, greyish, or of a light red tint, sometimes rather hard and tumid, sometimes soft and fungous; the individual granulations are few, pale, flabby, sometimes tall, but slightly vascular, of low organization, and for a long time possessing little sensibility; the discharge is copious, thin, slightly ropy with curdy flakes, or sanguineous; the pain is inconsiderable, and the skin surrounding them is of a remarkable, characteristic, purple colour. The course they pursue is also very characteristic; they are sometimes formed rapidly; they frequently remain indolent for a length of time, neither increasing nor diminishing in size; they suppurate for a long time, even for months or years, but they frequently change their characters, owing to the partial efforts which they make towards cicatrization, which contribute to render their course very irregular. When apparently at the point of healing, or partially cicatrized, they are apt to retrograde, and the cicatrix presents peculiar characters, being easily destroyed by the slightest irritant, and the ulcer renewed.

Fistulæ.—When tuberculous abscesses are deeply seated, they have a great tendency to degenerate into fistulæ; the external opening enlarging into ulcers with the above characters, or remaining as a small fistulous aperture. These fistulæ have little tendency to cicatrization or contraction. They may proceed from simple abscesses, from suppurating glands or diseased bones; they may originate in tubercular deposits or in simple tuberculous inflammatory and ulcerative affections; analogous fistulæ are occasionally observed in tubercular affections of the internal organs.

Scrofulous Hospital Gangrene.—The French writers describe this as occurring only in the wards of an hospital, and in humid and cold periods and seasons, modifying the characters of ulcers, particularly of those which are fistulous and connected with diseased

bones and joints. The surface of the ulcer rapidly enlarges, sometimes extending an inch in a night or day; if cicatrization has commenced, it breaks up and is replaced by a new ulceration, the surface becomes covered with clotted blood; on removing the clot, the disease is found to have extended to the areolar tissue beneath the derma; when the hæmorrhage is arrested the base of the ulcer is found coated with a concrete, greyish pus, and an extremely fœtid, ichorous, bloody suppuration ensues, destroying the areolar tissue, and dissecting the muscles and aponeuroses; after eight or ten days these formidable effects cease, and the ulcer resumes its curative tendency.* I cannot say that I have witnessed this as a prevalent disease, but it seems to indicate some sudden but temporary effect on the tuberculous blood.

Tuberculous or scrofulous cicatrices in the skin.—Their epithelium is extremely fine, allowing the subjacent vessels to be seen very clearly through it; these vessels are sometimes numerous, distinct, and large; at other times the whole surface is of a deep, but variable tint, becoming sometimes dark purple, sometimes bright red. They are seldom on the same level as the adjoining skin, and their surface is very irregular, owing to the irregularity of the granulations of the previous sore—sometimes serpiginous, at others with pedicles hanging loose, or with bands spreading across from one part of the sound skin to another; and the skin is frequently stretched and distorted, owing to the puckering of the scar—the deformity being considerably increased by the existence of muscular structure in its immediate vicinity, and adhesions, the motion of the skin over the muscle having been prevented. The whole organization of the cicatrix is peculiar; it is often for a long time soft, and the hair bulbs are destroyed so that hair never reappears on its site.

Cicatrices occasionally contain tubercle cells and granulations in their substance. They are liable, owing to the tensity and distensibility of their vessels, to change of colour from the slightest changes in the state of the circulation, and they exhibit the weakness belonging to all tuberculous structures, being always, so long as the blood continues in the slightest degree tuberculous, in danger of re-absorption from the action of trivial causes, and to the reproduction of sores. They sometimes shed crusts of epithelial layers at particular seasons of the year, corresponding with

* Encyl. des Scien. Méd., tom. xxvii., 236.

changes in the state of the blood, and sometimes without the skin giving way the epithelium is removed, and the dermis secretes pus. After scrofulous scars have existed for years, an accidental deterioration of health will occasion them to break out in this form or in open ulceration. In their malorganization they in some respects approach to the natural organization of the mucous membranes, tuberculous cicatrization in internal parts exhibiting similar characteristics.

Abscesses, ulcers and fistulæ, in Lebert's experience, are most frequent from five to twenty years of age; they are also frequent after twenty, and comparatively rare before five. They sometimes occur in several parts of the body simultaneously or successively, indicating a common origin from a morbid state of the blood. Their characters are essentially the same, whether the constitution of the individual be affected only to the extent of a predisposition to disease, or whether the blood be affected with tuberculosis as a disease, differing only in degree or in the extent to which the local affection is complicated with constitutional symptoms. They frequently alternate with other local tuberculous affections, which are generally described as "scrofulous." They constitute an important part of the special pathology of tuberculosis. Making allowance for the differences of structure and of the functions of different organs, tuberculous or scrofulous ulcers preserve a certain degree of uniformity, whether they occur internally or externally, or with or without the deposit of tubercle.

These affections are identical in character with similar pathological conditions proceeding from *tubercular* deposits, whether in the external or internal parts, which having softened and induced suppuration of the contiguous parts, find their way towards the surface. When they prove fatal, they do so by passing into some variety of internal or general complicated tuberculosis, with the deposit of tubercle in the internal organs. These facts clearly indicate, that the affections in question constitute a part of the special pathology of tuberculosis as a disease of the blood; and there is no ground for the absolute distinction which has been too generally made between scrofula and tubercle in this respect. Scrofulous children have sometimes throughout life the most unblemished skins, and tuberculous subjects are occasionally the victims of skin diseases.

Tubercle in the skin and subcutaneous tissues.—Although tubercle

is very seldom deposited in these structures, they are not totally exempt. General tuberculosis has occasionally manifested itself locally in the first instance in the skin only. Sir Philip Crampton relates an interesting example of this fact.* Tubercles of a caseous character, imbedded in the subjacent areolar tissue, penetrated the corion; some of them consisting of a tough, hard, fibro-cartilaginous substance without blood-vessels, had existed five years, when the patient became phthisical, and died in an extreme state of emaciation, the liver, lungs, and spleen being throughout in a tuberculated state. Laennec also describes an interesting, although very different case, which occurred in his own person. When about 25 years of age, examining some vertebræ, he received a slight scratch of the finger with a saw; the scratch inflamed, and there gradually formed, almost without pain, a small roundish tumour, apparently confined to the skin, which at the end of eight days was of the size of a cherry-stone; the epidermis cracked, and shewed the tumour within—yellowish, firm, and in every respect like a crude yellow tubercle; it was detached with caustic, which softened it, and made it like a soft friable tubercle, the walls of the cavity being of a pearl-grey colour, slightly semitransparent, and without any redness; after again cauterising, the part soon healed.† Laennec died of tuberculosis pulmonalis twenty years afterwards.

Bandelocque describes cases of lupus the bases of which were formed of distinct tubercles, which appeared to occupy the layers of the derma, and to be formed before the lurid redness and other characteristics of the lupus occurred; he considered it probable that the augmentation of volume of the tubercles occasioned congestion of the tissue around and between them, and hence redness, swelling, induration, and elevation of the superior layers of the skin, ulceration, and all the characteristics of this disease. ‡

The deposition of tubercle occurs occasionally in the subcutaneous cellular tissue in different parts of the body, in a form resembling absorbent glands; these swellings were named by Wiseman "adventitious glands," but they are composed of cysts lined with a fibrinous exudation, and are filled with tubercle,

* Transactions of the Irish Association, vol. v.

† Treatise on Diseases of the Chest. Translated by Dr. Forbes. Third edition, p. 336.

‡ Etudes sur les causes, &c., de la maladie scrophuleuse, p. 412.

sometimes crude and sometimes softened or converted into curdy pus. They are subcutaneous encysted tubercles.*

I have myself witnessed the formation of two distinct tubercles in the back of an individual of 60 years of age, who exhibited marks of scrofula in youth, and several of whose children died of phthisis; the parts surrounding these tubercles were made to suppurate with hot applications, and the cheesy tubercular matter was discharged, being followed by tuberculous suppuration, the parts ultimately healing. This individual died some years subsequently, after a paralytic seizûre.

Subcutaneous tubercles occasionally undergo the cretaceous transformation; they remain for a long time quiescent, and on extirpation, or should suppuration occur, masses of the chalky matter are evacuated.

On post mortem examination of tuberculous subjects generally, the skin presents no other change of structure than an aggravated degree of that mal-nutrition exhibited in the earliest stage of the disease. Sloughs occur in the usual situations from the patient being long bedridden, but it is said less constantly than in other diseases, owing to the diminished quantity of the fluids of the body. The areolar tissue is rarely infiltrated with serum so as to constitute local or general dropsy, except in extreme cases, when from local causes the lower extremities often swell. This œdema may result from the absorption of fat and adipose tissue, rendering the iliac vessels more liable to be compressed by the subjacent viscera, or from the formation of clots in the iliac veins, to be noticed in a future section. It has been observed that in this, as in other chronic diseases, the left extremity is more liable to become œdematous than the right, or becomes so in a greater degree, which may be accounted for by the left common iliac vein being covered, and more liable to be compressed by both common iliac arteries, whilst the right common iliac vein cannot be compressed by either of them.

SECTION II.

PATHOLOGICAL ANATOMY OF THE MUCOUS MEMBRANES AND OF THE SUBJACENT STRUCTURES IN TUBERCULOSIS.

I have already described the tendency of the mucous membranes to functional derangement in every variety and degree of tuber-

* Cycl. Pr. Med., vol. iv, p. 706.

culosis, and their liability to irritation, morbid secretion and inflammation. In the immature stages of the blood disease, in which external affections occur, classed together as "scrofula," these slighter affections are almost constant. Writers on scrofula, however, treating it as an external affection, rarely mention the pathological appearances of the mucous membranes. Nevertheless, regarding the disease of the blood as the parent both of external and internal tubercular affections, we must associate the anatomical appearances of the alimentary canal, ascertained after death, with the functional derangements which frequently occur from the commencement. Scrofula is comparatively little fatal; but, when fatal, the same ravages of disease are observed as in matured tuberculosis; in truth, as repeatedly urged, before a case of scrofula, at first a local and external affection, becomes fatal, if it pursue its natural course, it matures itself into a case of advanced general disease of the blood or confirmed tuberculosis.

The affections of the mucous membranes consist of increased vascularity, irritation, erosion, inflammation, thickening, ulceration without the deposit of tubercle, the deposit of tubercle succeeded by ulceration, mammillation, softening, contraction, and perforation. The different portions of these membranes are subject to each and all of these affections in very different degrees, and the character, progress, and termination of the morbid processes vary greatly, according to the age of the individual, the structure and function of the part, and the maturity or immaturity of the disease of the blood.

Some of the pathological terms have been ill understood or employed in different senses, it is therefore necessary to define them as used in the present work.

1. Mammillation.—The mucous membrane, instead of its natural uniform and velvety surface, presents, over a surface of variable extent, prominences of different forms and dimensions, generally rounded, of from one to two lines in diameter, resembling granulations, and separated from each other by deep furrows differing in length and one line or a little less broad.

2. Simple Erosions.—These are principally met with in parts which come in contact with tubercular matter and are also exposed to the action of the external air; they are the sequence of irritation of the mucous membrane. They are always superficial, nearly of a uniform size, rather oval, about the size of a lentil, ex-

cept when several have coalesced; their base is for the most part smooth and pallid, seldom slightly reddened, frequently covered with a thin, whitish, soft pellicle, their edges sharp and linear, whitish, or reddened, or scarcely discernible, and the surrounding mucous membrane very often quite pale. They present the appearance of having been made with a punch. These erosions are more frequent than ulcers.

3. Tuberculous Ulceration without Tubercle.—These are much larger than the former, more irregular in their outline, more frequently attended with evidences of inflammation, and more closely resembling the following variety, from which they are distinguished chiefly by negative signs as they present no appearance of tubercular deposit. It is important to remember, however, that tubercle in many cases of ulceration may have been deposited and passed away, leaving only the tuberculous ulcer.

4. True Tubercular Ulcers.—These occur in any part of the mucous membranes, but as respects various localities in which they have been observed, Louis disputes their tubercular character. Hasse thus explains their formation. Either tubercle accumulates within the capsules of the muciparous glands, elevating them, softening, and ultimately leaving corresponding ulcers; or, the tubercle is deposited in the mucous membrane: "instead of normal cells, tubercle cells form beneath the epithelium cells, crowd together, in part reach the surface, and are shed; in part irritate the contiguous textures, producing, first loss of substance, and afterwards ulcers." Sometimes they are more deeply seated. The generally well-marked tubercular granulations within them, and the determinate character of their microscopic elements, remove all doubt as to their true origin. They are larger than erosions, irregular in shape, prone to deepen quickly; their base is rough, as if gnawed, and the submucous texture thickened and hardened; their edges are prominent and abrupt, irregular and angular; although, when recent, they are more uniformly circular, having smooth, pale bases, with regular flat and soft edges, their circumference being pale, and formed of mucous membrane, and, if chronic, sometimes greyish, or of a deep red. At their bases, grey or yellow tubercular granulations are frequently discernible. Tubercular ulcers here, as elsewhere, invariably tend to spread, both superficially and in depth, owing to continual fresh deposition, aggregation, and softening at their margins and bases.

5. Granulated Muciparous Glands.—The muciparous glands are also sometimes affected independently of tubercle; they appear as white granules, about the size of mustard-seeds, in the midst of highly injected mucous membrane; they soften and leave excavated pits in the place of the granules. Hasse refers them to the influence of catarrh grafted on tubercle.

Some pathologists state positively that tubercle is never deposited on the surface of the mucous membranes. I have given the above from what I conceive to be the best authorities on the opposite side of this question.

I proceed now to detail the most salient points of the pathology of the different mucous membranes and of their particular parts.

A.—THE MUCOUS MEMBRANE OF THE RESPIRATORY PASSAGES.

1. *The Pituitary Membrane.*—In tuberculous subjects the pituitary membrane is extremely irritable and liable to copious thin and acrid secretions, and to small erosions. It is also extremely liable to chronic inflammatory action and muco-purulent discharges, sometimes inducing either a diffuse or a more circumscribed *hypertrophy,* and occasionally the formation of *polypi,* or ulcerations which degenerate into the disease known as ozœna. In these affections the laminæ of the bones are liable to become affected with caries. The deposit of tubercle on the more external and superficial parts of the membrane has not been noticed in the human subject, but in the glanders of horses Duprez has shewn the existence of tubercles in the nostrils.* Many cases of ozœna and diseases of the autrum and bones, some of those, for instance, narrated in Bordenave's memoir,† take their origin in tubercular deposit. Chronic inflammation of the membrane lining the nasal fossæ is a somewhat frequent affection.—In one case I found the autrum loaded with concrete tuberculous pus; so that there can be no doubt of the occurrence of a tuberculous ozœna, although cases coming under the description of ozœna have their origin more frequently in syphilis.

2. *Of the Epiglottis.*—This is subject to erosions and ulcerations. Louis found it affected in about one-sixth of his cases of phthisis,

* De L'Affection Tuberculeuse.

† On Surgical Diseases of the Head and Neck, Syd. Edit. Diseases of the Maxillary Sinus, p. 146.

most commonly on its posterior surface, spreading round its margin to the front; he accounts for this circumstance by that portion being brought into contact with the sputa. The whole organ is sometimes much deformed by tuberculous disease, and it has been known to be totally destroyed; it is sometimes ossified and sometimes bound down to the thyroid cartilage by thickened and degenerated areolar tissue.

3. *Of the Larynx and Trachea.*—The mucous membrane of the whole respiratory canal is liable to be more or less reddened, and in severe cases of tuberculosis of the lungs the discolouration occurs principally on the side which corresponds with the lung most affected. It is liable also to be thickened, eroded or ulcerated.

(*a*) *Ulceration.*—Louis found ulceration of the larynx in one-fourth of his cases of phthisis, and in the trachæa rather more frequently still. The most common seat of ulcers and erosions in the larynx, in Louis' cases, was the point of junction of the chordæ vocales, next to this the chordæ vocales themselves, especially at their posterior aspect, the base of the arytenoid cartilages, the upper part of the larynx, and lastly, the interior of the ventricles where he met but once with "a small superficial ulceration." In children, Rilliett and Barthez met with ulcers most frequently in one or other chordæ vocales, and next in frequency at their junction, once at the base of the epiglottis, twice on a level with the arytenoid cartilages, and twice disseminated over the larynx.

Ulceration of the larynx and trachæa sometimes begins simultaneously with the deposit of tubercle in the lungs, but, in a greater number of cases, tubercle is first deposited in the lungs. Hasse states, as a remarkable fact, that it occurs principally between the twentieth and thirty-fifth years, being far less frequent in advanced life. It is also less frequent before puberty. According to Louis, males are more subject to it than females, in the proportion of two to one.* Thus it would appear, that these affections are most common when the organ is in the full exercise of its function and when the disease of the blood is at its height.

Louis states, that ulcerations of the windpipe progressively increase in frequency from the epiglottis to the lungs, but Hasse, while remarking that tubercular ulcers progressively diminish from above downwards, states, that true tubercular lesions have their seat mainly in the larynx, and are rarely met with in the epiglottis

* Path. Anat., Syden. Ed., p. 356.

and trachæa exclusively of the larynx. This apparent discrepancy arises from the distinction made by Hasse between erosions, non-tubercular ulcerations, and true tubercular ulcers.

(*b*) *Tubercle.*—Much difference of opinion has existed as to the occurrence of tubercle in the larynx. The question has arisen—why should the mucous or submucous membrane be exempt in this situation, while the deposit occurs so frequently in the intestines?—and this has only been replied to by the fact, that the aggregation of tubercle in the portions of the tegumentary membranes exposed to the external air is very rare. Many pathologists have totally denied their occurrence. Andral gives very equivocal testimony in favour of it. Louis never met with tubercle in this part of the respiratory canal. Tonnelé published a case of tubercle in the larynx occurring in a girl aged 14 years; republished by Rilliett and Barthez; and the latter met with one case of tuberculization of the trachea. Hasse mentions numerous miliary tubercles, sometimes discernible in the submucous tissue; and he has more than once found tubercle deposited in the space intervening between the cricoid and one or both arytenoid cartilages, and this in cases where no true ulcers were observed.* He considers that these tubercles soften and engender ulcers. It is now generally conceded that tubercle occurs in many of those parts which were formerly believed to be exempt, and that ulceration by no means infrequently takes its rise from tubercular deposit which has escaped.

(*c*) *Ulceration in children.*—In children ulceration of the larynx and trachea coincides with very general tuberculization, and with the concentration of tubercle in the lungs especially. The ulcers described by Rilliett and Barthez have for the most part the character of erosions. They once only met with an ulcer nearly a quarter-of-an-inch long by an eighth broad. The mucous membrane around them was in about half the cases inflamed, and in the other half healthy. In nearly all the cases the bronchiæ were also inflamed, but rarely softened or ulcerated; and they almost always contained a large quantity of fetid, sanious fluid. Except in a few cases, in which they were very few and very small, ulcers were not met with until after seven years of age, and never under three years.

In 312 infants they found ulceration 16 times: viz.—in the

* Lib. cit., p. 361.

larynx alone, nine times; in the trachea alone, four times; in the larynx and trachea, three times.*

Hasse states that when true tubercular ulceration in the respiratory canal spreads inwards, the subjacent textures undergo changes. The perichondrium and cartilages ulcerate, but, previously to this process, a deposit of phosphate and carbonate of lime generally takes place between the perichondrium and cartilage. This deposit previously appears in the shape of irregular, rough, little scales, which progressively enlarge and encroach upon the cartilage until this is destroyed,—one compact bony matter having assumed its place. This change most frequently occurs in the posterior portion of the cricoid cartilage; next in frequency in the thyroid; far more rarely in the arytænoid cartilages. Of this kind of ossification, four cases only are known to have occurred in the epiglottis, but Hasse frequently found the rings of the trachea and bronchi thus transformed.

Rare examples occur of ulcers in the back part of the larynx, extending to and perforating the œsophagus.

Not only is it rendered clear, that ulceration in the upper respiratory passages is a pathological condition proper to tuberculosis, but that tubercle is occasionally deposited in this situation; and although, doubtless, acrid sputa proceeding from ulcerated lungs will always aggravate and perhaps frequently induce the ulceration above, there are still independent causes of this ulceration in the local influences to which the parts are subject, and the tuberculous state of the blood.

4. *Of the Bronchi.*—The bronchial tubes constitute a very important anatomical element for investigation. Exposed to the influence of the external air on the one hand, to the circulation of arterial blood in their parietes, and taking their rise from the air vesicles of the lungs, there can be no surprise that they should present a great variety of pathological appearances. Hence we find enumerated: increased redness, puffiness, thickening, secretion of purulent mucus, erosion, and ulceration of their mucous membrane; obliteration of their minuter twigs, dilatation of their larger branches, plugging of their calibre with tubercle, and the deposit of tubercle under their mucous coat and in the depth of their parietes. Pathological anatomists appear to have found greater difficulty here than even in the upper parts of the respi-

* Lib. cit., p. 371.

ratory tube, in distinguishing between primary tuberculous affections and those which result secondarily from the deposit of tubercle in the lungs.

(*a*) *Ulceration.*—Louis found ulceration more frequently in the bronchi than in the trachea,—22 times in 49 cases,—and much more frequently in men than in women. He found those bronchi only which communicate with or are seated in the immediate vicinity of cavities in the lungs exhibiting signs of violent inflammation. In one case, where the lung contained tubercles, Louis found a tuberculous false membrane in the interior of one of the bronchi, easily separable from the subjacent mucous membrane, which had retained its natural whiteness, thickness, and consistence. Louis maintained, that ulceration is generally produced by the sputa; and he remarked, that the membrane frequently retains its white colour before tubercles soften in the lungs, and then becomes reddened. But subsequent observations by pathologists of immense experience have left no doubt that the bronchi are sometimes ulcerated without cavities in the lungs; and it is admitted that tubercle may be deposited primarily in the structures constituting the parietes of the bronchial tubes.

(*b*) *Tubercles.*—Tubercles with yellow or grey semi-transparent granulations are so infrequent, that Louis laid it down as a law of the system, that they are never produced in the bronchi after the age of 15; but exceptions to this rule have been detected since. Andral states, that the mucous membrane of the bronchi is frequently the seat of tubercle.

Bronchial tuberculosis is, however, met with chiefly in children, and is commonly accompanied with most extensive tuberculous disease of the bronchial glands. Rokitanski says: "It is a disease of the terminal branches of the bronchi;" at least, it developes itself originally in them, and extends from them into the larger tubes. It occurs especially, like pulmonary tuberculosis, in the bronchi of the upper lobes, but is contrasted with phthisis, in that it is frequent in the peripheral or superficial ramifications, affects a larger section of the bronchial tree, and that, on a transverse section, the pulmonary parenchyma is found traversed by large, thickly-walled, bronchial tubes, filled by caseous tubercular matter. It is often combined with tubercular infiltration of the pulmonary parenchyma, but often is completely independent. In the latter case, the obstruction of the bronchial tubes leads to obliteration of

the vesicles, and wasting of the parenchyma connected with them; and then the obstructed tuberculous bronchi are converted into a ligamentous, shrivelled, elastic, and tough tissue. The tubercular matter, in these cases, passes through its usual changes. It either softens, and then the bronchial walls are not infrequently destroyed, and involved in collections of tubercular pus,—collections in which (contrary to those which are far more frequently formed by softening of pulmonary tubercle) the destruction of the bronchi is the primary change; or else the tubercular matter undergoes the calcareous metamorphosis, which is especially apt to occur when the bronchus has been completely closed by tubercle.

This description, as remarked by Rokitanski's reviewer, (British and Foreign Review,) is the more important, because it affords a correct account of that tubercular disease of the bronchi in which Dr. Carswell has, far too exclusively, made ordinary phthisis to consist; and of which others, with an equally unfounded exclusiveness, have denied the existence.

B.—THE MUCOUS MEMBRANE OF THE DIGESTIVE CANAL.

1. *Of the Mouth and Fauces.*—This part of the mucous membrane is frequently reddened, and occasionally ulcerated in tuberculous subjects. The ulcerations are referred to aphthæ by some writers; they are generally small erosions, shallow, elongated, or rounded, or stripe-like, with slightly concave bases; sometimes they are scarcely discernible, appear raw or excoriated, pale or dark red, are uncovered or covered with a creamy diffluent exudation, and are surrounded with a livid redness, or a sharply defined red areola. They generally extend into the fauces and mouth from the larynx and trachea, where similar erosions occur, and are most frequently seated on the side where one of the lungs has been most extensively or most severely diseased.

(*a*) *Of the Tonsils.*—Their habitual hypertrophy has already been described, but these organs are liable to a constant hyperæmia, and, as remarked years ago by Wiseman, to a peculiar blennorrhœa, the secretions sometimes becoming inspissated so as to form tubercular cheesy plugs, or even chalky concretions.

(*b*) *Of the Tongue.*—Erosion is an occasional occurrence. Dr. Cumin describes a scrofulous affection of this organ sometimes in the form of aphthæ with fissures in the margin, but mostly

characterized by nodules imbedded in its substance, varying from the size of a small shot to that of a horse-bean, occurring successively, ulcerating, spreading, and destroying by sloughy erosion.* Hasse once detected the tongue studded from root to point with little ulcers, evidently tuberculous.

(*c*) *Of the Pharynx.*—Ulcers are occasionally observed in the pharynx. Louis found them numerously scattered and small in four cases among 120 subjects.

Rilliet and Barthez found tuberculous infants occasionally affected with pharyngeal ulceration in form and appearance resembling tuberculous ulceration elsewhere, as in the intestines. In one case the posterior and lateral surfaces of the pharynx were deeply ulcerated, the ulcers being irregular, with deep-red, flabby, projecting edges, their bases formed of thickened submucous tissue, and here and there red soft mammillation.

2. *Of the Œsophagus.*—The œsophagus was ulcerated in six cases of Louis' 120 phthisical patients, and Hasse found ulceration extending from the posterior surface of the epiglottis to the œsophagus. Rokitanski states, that tubercular deposits rarely, if ever, form in the œsophagus, and he gives a caution against confounding their existence here with tuberculization of the neighbouring glands. The lower part was softened and attenuated in three of Louis' cases, the disease affecting all the tissues and extending to the stomach.

3. *Of the Stomach.*—The very frequent occurrence of dyspeptic affections in tuberculous subjects, and of violent symptoms referrible to the stomach in some of the most severe forms of tuberculosis, gives a peculiar interest to the pathology of this organ. The mucous membrane was healthy in one-fifth of the cases of tuberculosis pulmonalis examined after death by Louis. Louis demonstrates the effects of inflammation in many cases, but thinks they are sometimes the result of chemical and mechanical causes, and that inflammation frequently sets in during the latter days of life, as in the pleuræ and lungs. The ulcers observed were from one to eighty in number, but generally few. In every case but one the mucous membrane retained the same thickness, consistence, and colour, around as between the ulcerations. In 56 cases he never found grey granulation or yellow tubercle, either in the substance or beneath the stomach. Andral met with tubercles in the stomach

* Cycl. Pr. Med., vol. iv, p. 707.

about twice in several hundred subjects. Rokitanski states that tubercle and tuberculous ulceration are very rare, and primary tuberculosis of the stomach almost unknown. When tuberculous ulcers occur they generally extend from the ileum, through the jejunum and duodenum to the stomach, and are then most frequently limited to the pyloric portion, but sometimes extend to the fundus.

In 96 cases Louis found the stomach :—

Attenuated	19	times.
Red and somewhat thickened, mammillated and softened on the anterior surface	8	,,
Softened, and of a dull or brownish red colour at the fundus	17	,,
Mammillated, greyish, sometimes reddish thickened	19	,,
Ulcerated, without any other change	2	,,
Softened, without alteration of colour or thickness	4	,,
Of a more or less bright colour over the entire surface, without alteration of consistence or thickness	6	,,
Raised up by a viscid liquid	1	,,
Presenting the appearance of cicatrization	1	,,
	77	,,

Thus, in a great proportion of the most inveterate and fatal cases of tuberculosis, the signs of inflammatory action in the stomach are unequivocal and severe, yet the deposit of tubercle is at most a very rare occurrence,—a circumstance which goes far to dissociate the local production of tubercle from the inflammatory process. The morbid appearances above described are met with in other chronic diseases in the proportion of perhaps one-half the cases, whereas in tuberculosis they occurred to Louis in four cases out of five. Rilliett and Barthez found inflammation and softening of the stomach a common occurrence in tuberculous infants, and softening was especially frequent in those who died of meningitis; but they regard the latter circumstance, in the greater number of cases, as a *post-mortem* effect.

We have the authority of Andral, Clark, Todd, and other pathologists in support of the opinion that symptoms indicating many of these pathological states of the stomach frequently occur in tuberculous subjects where the blood already is, or is rapidly becoming, matured for the deposition of tubercle before tubercle is actually deposited in the lungs, and before symptoms of pulmonary disease set in.

4. *Of the Intestinal Canal.*—The deposit of tubercle occurs much more frequently here than in any other part of the mucous membranes, but there is reason to believe that the ulcerations which are met with, being the result of tuberculosis, are not always produced by the deposit of tubercle. At all events, in a great proportion of instances, they leave no vestiges of the specific morbid element. They are the result of the ulcerous diathesis of the disease, and analogous to the ulcerous tendency exhibited in external scrofula. The digestive tube exhibits a remarkable tendency to chronic inflammation and all its consequences, and these affections are of the more importance, since upon them frequently depends the rapidly fatal result. The local affections of the lungs oppose obstacles to the assimilation of air, and the local affections of the intestines oppose obstacles to the assimilation of aliment; hence, to a certain extent both respiration and primary assimilation are arrested.

Tubercle is for the most part deposited, according to Carswell, in the mucous membranes of the mucous follicles; and, according to other pathologists, in the submucous areolar tissue, and sometimes in the lacerti of the muscular coat; hence the mucous membrane is sometimes found above the tubercle without any appreciable alteration, or merely injected. It occurs more frequently in the small intestines than in any other part of the intestinal canal, in the form of crude tubercle and soft yellow granulations. In the first case the submucous areolar tissue is preserved, giving the tubercle a harder consistence. In both cases, the character of the tubercle is precisely the same as in any other part of the body.

Condensing Rokitanski's description, the following appear to be the essential features in the pathological anatomy of tuberculosis intestinalis. Tubercle aggregated in the intestinal mucous membrane, and by extension in the deeper seated coats, is a most important variety of the disease. In adults it occurs rarely, in children more frequently, as a primary form. It occurs more frequently as secondary to the deposit of tubercle in the lungs, taking place after the latter has assumed the suppurative stage. It is frequently chronic, but oftener acute. In the chronic form the tubercle is originally deposited in the mucous membrane and submucous areolar tissue; there is no perceptible imflammatory action; it appears as grey transparent granulation, which softens at its centre, and is gradually converted from within outwards into the yellow cheesy tubercle; it appears to be blended with the

mucous membrane, and projects into the intestinal tube in the shape of a sessile hard nodule.

In the acute form there is considerable inflammatory action; the tubercle is first deposited in the cavities of Peyer's glands, then in the solitary follicles, and lastly, in every other part of the intestinal mucous tissue; it appears in large masses, and in the shape of yellow cheesy matter; the surrounding tissue is extremely congested, and suppurative and ulcerative destruction are speedily effected.

Tubercular deposit in this situation is for the most part the result of fully developed tuberculosis; softening is effected with great rapidity, the mucous membrane gives way, the tubercular matter escapes, and a cup-shaped ulcer results; its margin is firmly attached, rounded, and indurated,—of a pale or red colour, in proportion to the reaction in the surrounding tissue; its base is formed by the condensed areolar layer, or by the granulated textures of the parietes of the dilated follicles; the increase of the ulcers takes place with more or less rapidity, and they lose their original form to exchange it for a more characteristic secondary one.

The increase of a tuberculous ulcer in the intestine is effected just as in the lung,—by fusion of the tubercular infiltration of the margin, and by concurrent suppuration of the tissue. In the first place, small adjoining ulcers coalesce into one of larger size; the common base presents sinuous projections of the common margin of mucous tissue; the margin of the enlarged ulcer is sinuous or dentated, inverted, and tumid, and is formed of mucous membrane of light red colour; but this is infiltrated with transparent gelatinous substance analogous to the gelatinous infiltration of pulmonary abscesses. Beneath the callous base the remaining intestinal layers are condensed and tumefied. At the margin and at the base, there is deposition of grey, or, more commonly, of soft yellow tubercle.

Rokitanski's description of the further progress of these pathological changes is most interesting, and highly indicative of the inveterate character of the morbid condition of the blood in these cases. The tuberculous ulcer may extend in depth as well as laterally. Secondary deposition of tubercle may take place equally in the callous areolar tissue of the base; and, as it fuses in this point, into the muscular and subserous layers also; the perito-

neum may become perforated from suppuration or mortification. When the peritoneum becomes inflamed, a fibrinous exudation results, which is replaced by tubercle, and adhesions are formed with neighbouring organs.

The healing process in intestinal tuberculosis is also most instructive. The first indispensable condition is the cessation of all secondary tuberculous infiltration at the margin or base of the ulcer; the callous base is then condensed into a fibrous cord, and the edges of the ulcer approach each other. This process sometimes advances so far, that the dentated edges almost touch, and between them a whitish callous cord may be observed; occasionally the edges are soldered together over the callosity, yet so as to leave a fissure at one end of the ulcer, and in rare cases an entire consolidation is effected. By contraction of the ulcers, a cicatrix on the surface is promoted, which presents a more or less tumid edge on the internal surface of the intestine; and if the ulcer be of considerable size, or if it encircle the entire intestine, a callous annular ridge remains, which diminishes the calibre of the intestine. The cure of an intestinal tubercle is always accompanied by a diminution of the intestinal calibre.

It may be here stated, that Cruveilhier, on examining an adult subject, in which the lymphatic vessels were filled with tubercle, traced one of these vessels throughout the length of each villus, as far as the *ampullæ of Lieberkuhn*, which were filled with tubercular matter.

Lebert's account of an attentive examination of the minuter changes which occur in a portion of the mucous membrane of the intestine, in which tubercle has been deposited, is as follows:—

The membrane is found, at first, to be perfectly sound, then slightly raised by the aggregation of tubercular matter; and it is not until subsequently, that it becomes injected and softened. Ulceration ultimately occurs, and this, as in other parts of the body, is the effect of the presence of the foreign body. When ulceration is established a thickening takes place in the surrounding tissue, which increases in proportion as it extends. The submucous tissue and the muscular coat participate in this thickening, and thus oppose a barrier to perforation of the intestine.

Deposit of tubercle in the digestive canal occurs in every degree, from a few disseminated tubercles to the most extensive aggregation. Lebert once found a single tubercle along the whole

intestinal canal, with a series of tuberculous ulcers from the commencement of the ileum to the rectum. This pathologist never met with the semitransparent grey granulation in the digestive tube, and appears to doubt its occurrence. Other pathologists have left no doubt upon the subject. I lately examined a case in which its existence was unequivocal.

Lebert thus describes the microscopic view of the detritus which covers tuberculous ulcers of the intestine: It is a mixture of cylindrical epithelium and shreds of mucous tissue; around the detritus, circles of vascular injection present themselves, and sometimes the lymphatic vessels appear to be filled with tubercular matter. Tubercle in the intestines undergoes softening, disaggregation, disorganization of its corpuscles, and final destruction, just as in other parts of the body.

The ulceration progressing, the borders of the ulcers become broken, and as it were lacerated, and present a reddish brown and sometimes a blackish tint; the latter being partly produced by the acids of the intestinal canal, and partly by melanotic deposit, which sometimes occurs in the borders of intestinal ulcers.

(*a*) *In the small Intestines.*—In Louis' experience, softening is very common, but not more so than in other chronic diseases; it generally implicates the whole tract of the canal, and in some cases thickening and bright red discolouration coexist. In many cases the bowel is red throughout its entire length; in other, redness is limited to a small portion. The duodenum is most frequently exempt from these changes.

Hard semicartilaginous granulations occurred frequently, and were accumulated in great numbers, and scattered throughout the entire tract, or in patches. They were always seated under the mucous membrane,; never occupying the interstices of the muscular fibres; and were, doubtless, an early stage of the development of tubercle, being of recent origin at the period of death. Tubercular granulations, properly so called, succeeded by ulcers produced by the same process as ulcers in the lungs, were seated in the interstices of the fleshy fibres, and between the peritoneum and the muscular coat. Of 120 cases of phthisis tubercular granulation occurred in 54. In some cases the hard granulations were found associated with the tubercular granulations; and when both kinds coexisted, those of the hard species were less numerous than when present alone.

Ulcerations of the small intestines presented themselves in five-sixths of the cases; being about twice as frequent as tubercular deposit. They vary in diameter from one line to five or six inches; small ones are round; those of medium size elliptical; and the large ones annular or linear. Their number, size, and depth increase the nearer the cœcum they are observed; they almost always commence opposite the mesentery in Peyer's glands,—which, as the ulcers enlarge, are totally destroyed, and the whole circumference of the bowel becomes involved, pretty frequently producing contraction. Sometimes small abscesses, about the size of a pea, are developed in the submucous tissue.

In the tuberculosis intestinalis of children, hard semi-cartilaginous granulations are *rarely* found, softened miliary crude tubercle is almost the only form which occurs. Patches of Peyer's glands are sometimes studded with yellow points, which on careful examination are found to be true tubercles. The progress and effects of intestinal tubercles do not differ materially in children and adults.

Andral found tubercle in the parietes of the gall bladder and in the course of the biliary ducts.*

(*b*) *In the large Intestines.*—Similar morbid changes occur. Softening is of frequent occurrence. It occurs with redness and thickening, indications of previous inflammation, but frequently without them. The deposit of tubercle is much less common than in the small intestines. In 120 cases Louis met with eight instances only. Ulceration, on the contrary, is almost equally common in both portions of the tract. In the 108 cases there were only twenty in which ulceration was not discernible. When of small size, the ulcers are generally uniformly distributed and of the character of *erosions*. Ulcers of a larger size presented all the characters belonging to tuberculous ulcers already described; these become less frequent as they progress from the cœcum.

The small ulcerations are generally round, greyish or blackish, sometimes of a delicate rose colour; sometimes, as with ulcerations of medium size, they are elongated; being from one to two inches long and two or three lines wide. The large ulcers are irregular, denticulated, etiolated, sometimes involving the cœcum, and the whole course of the colon and the rectum. They are sometimes limited to the cœcum and right colon, and one ulceration occupies the whole space for eight or nine inches or more. In some cases,

* Clin. Med., p. 335.

in the middle of these vast ulcerations, a zone of perfectly healthy intestine is observed, or a portion is only slightly softened, or there may be seen here and there a kind of islet formed by the debris of mucous membrane and areolar tissue.

Andral met with but one case of *fistula in ano* in about 800 subjects labouring under tuberculous disease in various stages, and Louis's experience is similar.

(*c*) *In the Intestinal Mucous Membranes in Infants.*—In infants and young children almost the only species of tubercle detected by Rilliett and Barthez was the miliary yellow tubercle and yellow granulation; grey granulation and semi-cartilaginous tubercle were very rare, and they scarcely met with yellow infiltration. The tubercles never attain a large size, and they soften with the greatest facility, leading to ulceration, and occasionally to perforation; the ulceration always tends to spread, and the tubercular matter is rapidly eliminated and carried away with the contents of the mucous canal. When this has occurred the ulceration alone remains; and these gentlemen make the important remark, that its tuberculous character may frequently be overlooked. In infants the same curative processes are set up as in adults, and it is a very rare circumstance to find tubercles progressing from the external or free surface or the peritoneal surface, and perforating the subjacent membranes. Rilliett and Barthez detected tubercles in the mucous membrane of the gastro-intestinal canal only; but ulceration, without evidence of tubercular deposit, is frequently met with, as in the adult, in other parts of the mucous tract.

They observed tubercles and tuberculous ulcerations in 141 cases. According to the following proportions:*—

In the stomach	21
,, small intestines	134
,, large intestines	60
,, the above three parts simultaneously	11
,, stomach alone	,,
,, small intestines alone	71
,, large intestines alone	7
,, stomach and small intestines alone	10
,, stomach and large intestines alone	,,
,, small and large intestines alone	42

The 21 *Diseased Stomachs exhibited—*

Extensive disease	2
Less extensive	4
Disease of small extent	15

* Maladies des Enfans, tom. iii, p. 437.

Ulcerations	20
Tubercles	7
Tubercles with ulcerations	6
Tubercles without ulcerations	1
Ulcerations without tubercles	14
In 134 *Diseased Small Intestines—*	
Extensive disease	50
Considerable disease	14
Disease of small extent	70
Ulcerations	121
Tubercles	82
„ with ulcerations	70
„ without ulcerations	12
Ulceration without tubercles	51
In 60 *Diseased Large Intestines—*	
Extensively diseased	10
Considerably diseased	18
Disease of small extent	32
Ulcerations	57
Tubercles	15
„ with ulcerations	10
„ without ulcerations	5
Ulcerations without tubercles	47

This table shews that tubercles without ulcerations are equally rare in the large and small intestines, while ulcerations without tubercles are much more frequent in the large than in the small intestines of children.

Different statistical results have been obtained by pathologists of other countries,* and my own observation leads me to question whether intestinal disease is so frequent a result of tuberculosis in this country as in France.

C.—THE MUCOUS MEMBRANE OF THE URINARY ORGANS.

Like the respiratory and intestinal mucous membrane, this is frequently the seat of chronic inflammation, and of muco-purulent discharges, and of ulceration, in individuals predisposed to tuberculosis; which affections are sometimes associated with other external tuberculous diseases coming under the designation of scrofula. This membrane is also occasionally the seat of tubercle, which, as in the respiratory and intestinal mucous membranes, is less frequent the nearer it approaches the external surface. Rokitanski thus describes tubercle of the urinary mucous membrane:—

* British and Foreign Review. July 1848, from Henle.

"The earlier stages and the chronic course are marked by grey millet-sized granulations in the sub-mucous cellular tissue, which speedily become yellow, soften, and, after perforating the mucous membrane within a ring of re-active inflammation, give rise to small circular ulcers, which but rarely enlarge to the dimensions of a pea or a bean. When the disease is more acute, the mucous membrane is attacked in larger sinuous or annular patches; or becomes infiltrated throughout with the tubercular product of inflammation, which is at once detached as a cheesy purulent mass; the membrane is superseded by a thick, yellow, fissured, and purulent layer, the external cellulo-fibrous portion of which presents a lardaceous character, the calibre of the canal being enlarged. In the parts which are free from the tubercular deposit, numerous aphthous erosions, resembling those described as occurring in the larynx, are frequently observed."

Rokitanski believes that tubercle of the urinary mucous membrane is usually extended from the genital organs, in which it occurs primarily.

1. *Of the bladder.*—Chronic tuberculous cystitis occurs, leaving the organ red and injected on its internal surface, and this may extend itself through the ureters to the kidneys. Tubercle of the mucous membrane of the bladder is very rare; Louis found it in two cases only out of 200. It is commonly associated with tubercle of the urethra and prostate gland; it assumes the form of discrete granulation only, and is deposited with more or less reaction and vascularity; it softens, breaks through the mucous membrane within a circle of vessels, and forms a small roundish ulcer. The cervix and fundus are its usual site. In one of Louis' cases the mucous lining of the bladder was completely destroyed.

2. *Of the ureters.*—Tubercle sometimes fills the interior of the ureters, and extends to the chambers of the kidneys.

3. *Of the urethra.*—Rokitanski states, that tubercle and tuberculous ulcerations occur in the urethra only in conjunction with tuberculosis of the entire urinary apparatus. Rayer gives a case of a man, aged 31, who had also tubercle in the kidneys, the testicles, &c.; and another of a boy, aged 12, in whom they occurred over the entire length of the urethra, associated with tubercle in the kidneys, peritoneum, &c.

Ricord mentioned a case of an individual, 58 years old, in which the whole mucous membrane of the urethra was infiltrated with a

multitude of miliary tubercles, some of which were aggregated, softened and ulcerated. A large tuberculous abscess existed in the prostate gland, and, some years previous to death, a tuberculous testicle was removed from the same patient. The symptoms were those of obstinate gonorrhœa. M. Ricord has met with but one other instance.

D.—THE MUCOUS MEMBRANE OF THE ORGANS OF GENERATION.

1. *Of the Male Organs.* (*a*) *Of the Epididymis.*—The deposit of tubercle sometimes commences in the epididymis, and spreads throughout the membrane of the entire tract of the male urinary organs to the kidneys.

(*b*) *Of the Vesiculæ Seminalis.*—Tubercle deposited in this situation is by no means an infrequent occurrence. The mucous membrane is found, after death, converted into a thick, yellow, cheesy or lardaceous, fissured, purulent layer of tubercular matter, filling up and closing the passage of the seminal vesicles; the superficial layer of their coats being thickened and infiltrated. The external investment is also occasionally the seat of deposit which softens, suppurates and perforates the seminal vesicles.

This disease is associated with tubercle in the testicle and male organs of generation, and the glands which belong to them, and with tubercle in the urinary apparatus. In 100 adults, Lombard found one case with tubercles in the vesiculæ seminalis.

Tubercle has been also found in Cowper's glands.

2. *Of the Female Organs.* (*a*) *Of the Uterus.*—M. Raynaud gives a case, which Louis quotes, where softened tubercular matter flowed from the uterus, the interior of the cervix being lined with a stratum of tubercle. Carswell represents the cavity nearly filled with masses of cheesy looking tubercle, the walls being thicker and more vascular than in the ordinary state, and containing two or three small masses; the patient died of phthisis. Other cases of tubercle accumulated in the cavity of the uterus are recorded. Rilliett and Barthez mention one occurring in a young girl.

(*b*) *Of the Fallopian Tubes.*—These are frequently loaded with tubercle. In the case quoted above from Carswell they were dilated; the left was filled with soft tubercular matter, and the right with a turbid milky-looking fluid. In another case the tube was dilated, tortuous, obliterated at its superior extremity, filled

with tubercle, perforated and adhering to the uterus at a point about the middle of its length (Pl. II, f. 2).

(*c*) *Of the Vagina.*—In tuberculous children, chronic inflammation of the mucous membrane of the vagina, accompanied with a mucous discharge, is by no means rare. In adult tuberculous subjects, leucorrhœal discharges are very common. Scrofulous ulcers are occasionally detected in the vagina, but even in extreme cases of the most complicated tuberculosis, the vagina is rarely affected with tubercle. In M. Raynaud's case, where softened tuberculous matter flowed from the uterus, a multitude of ulcerations were detected in the vagina. The ulcers were much more numerous at the posterior than at the lateral parts of the canal, and there were none on the anterior surface. This corresponds with a similar occurrence, so frequently observed in the trachea and upper parts of the air passages, in which Louis attributes the ulceration to the action of the discharge. In a case where the uterus was tuberculated without any suppuration, there were no ulcers in the vagina.

The history of intestinal ulceration contained in the works of Louis and Rokitanski, demonstrates that tuberculous blood produces anæmia, softening even to liquefaction, and predisposes to congestions, irritation and inflammation of the mucous membranes, irrespective of the deposit of tubercle. That erosions and ulcerations may occur in the subjects of tuberculosis without previous inflammation, that the deposit of tubercle, in a majority of instances, is not to be imputed to inflammatory action, and that inflammation is more frequently the effect than the cause of the presence of tubercles.

It is most important to study the ulcerative and suppurative tendency of tuberculosis as respects the skin and the whole mucous surface together. Taking the descriptions of various pathological anatomists, how essentially identical is the process of tuberculous erosion and ulceration in the larynx, trachea, bronchi, intestinal canal, and urinary mucous membrane, and can there be a doubt that the scrofulous ulcer of the external surface and the tuberculous ulcer of the mucous membrane are essentially the same, allowing for differences of organization, different periods of life, and the maturity or immaturity of the blood disease. Tubercle is rarely deposited in the skin, and so is it rarely deposited in those mucous membranes which have closest access to the external air—the

upper part of the respiratory canal and the lower parts of the urinary organs. The skin is extremely liable to tuberculous ulceration—that is to say, ulceration of a peculiar character, depending upon the morbid state of the blood—without the deposit of tubercle. So are the mucous membranes. The erosions which occur in the larynx, trachea, vagina, and urethra, are the analogues of the slighter cutaneous eruptions of scrofula. The problem to be solved is, why should the external surface be most liable to the affection at one period of life, and the mucous membranes at another? and also, why is the deposition of tubercle so much more frequent an occurrence in the internal mucous surfaces than in the skin and the terminal mucous membranes? This will come under consideration in a future chapter. The analogy between the symptoms, progress, and termination of an ulcer in a tuberculous subject where there is no separate and distinct manifestation of tubercle, and an ulcer which obviously proceeds from previous tubercular deposit, whether in the external or internal organs or surfaces, is also obvious. This will be more striking when the pathology of the lymphatic glands in tuberculosis is before us.

To account for the infrequency of the aggregation of tubercle in the skin, and the free surfaces of mucous membranes, Sir J. Clark truly observes, there is no difficulty in conceiving that the matter formed in some of these cutaneous affections would have assumed the character of crude tubercle, had it been confined to the parenchyma of organs, or to the extreme bronchial ramifications.*

We have shown the defective cell nutrition in every degree and form of tuberculosis, but it is nowhere more remarkably illustrated than in the case of a solution of continuity or ulceration of the dermoid and mucous tissues. The blastema from which these tissues have to be renewed, and in which cells, areolar tissue, blood vessels, and epidermis or epithelium are to be produced, being defective, union by the first intention is defeated, granulations are imperfect, and pus is vitiated. The chronic character and intractability of scrofulous and tuberculous sores are thus accounted for. Where the blood is tuberculous, that is to say, possessing the qualities I have described, its fibrine being deficient, its albumen vitiated, its watery element increased, its vitality diminished, could it be expected, *à priori*, that the granulations in a sore, if they form at all, would be firm, or that they would contract after the

* Cycl. Pract. Medicine, vol. iv, p. 326.

manner of granulations produced from the blastema exuded from healthy blood?

SECTION III.

THE PATHOLOGICAL ANATOMY OF THE SEROUS MEMBRANES IN TUBERCULOSIS.

In individuals of the tuberculous predisposition from various causes, as the tenuity of the blood, or the delicate structure of some of the serous membranes, the natural serous effusion may be easily increased in quantity. In a great proportion of fatal cases all these membranes are the seat of a more or less abundant accumulation of fluid. Tuberculous subjects appear to be particularly subject to chronic and acute inflammatory affections of the serous membranes, produced by the usual occasional causes of inflammation, as well as by the deposit of tubercle. These inflammations are met with in children as well as adults; they occur when the blood is only slightly tuberculous, its tuberculization being immature, when they run a course differing somewhat from the ordinary course of inflammation in otherwise healthy subjects, but without the deposit of tubercle in any of the tissues or organs. These membranes are also the frequent seat of inflammation at the close of life. The serous membranes, in matured tuberculosis, are also liable to the deposit and aggregation of tubercle totally irrespective of inflammatory action. This deposit may either be primary or secondary,—that is to say, it may take place during the progress of tuberculosis before tubercle has been deposited in any other organ,—by far the rarer case,—or after it has been deposited in some other tissue or organ, and especially in the lungs or absorbent glands. The tubercles, in their simple and uncomplicated state, are usually found in the subserous areolar tissue or visceral aspect of the serous membrane; but collections are by no means limited to this surface; they occur on the free or unattached surface; hence they have been termed *extra* and *intra* serous tubercles, and, according to some pathologists, they are met with in the substance or intimate structure of the membrane. Gelatinous, semi-transparent grey or yellow tubercle, either as miliary granulation, distinct tubercle, in layers or in the infiltrated form, are met with, but by no means equally in all these membranes, and there are several remarkable specialities in this respect. While in the state

of miliary granulation, they usually assume a lenticular form; and extend into plates or laminæ when abundant; the form being attributable to the stretching of the membrane over a resisting tissue. Softening of tubercle, but more particularly ulceration in this tissue, as compared with the skin and mucous membranes, are rare; and the serous membranes frequently oppose themselves to the extension of ulceration from the subjacent parts. These membranes, however, occasionally give way by rupture from pressure and distension, and occasionally by the extension of ulceration, constituting perforation. In children, tuberculization of the serous membranes sometimes occurs to a very great extent, and nearly to the exclusion of all other organs, the deposit, under these circumstances, accompanying all the most aggravated symptoms of general tuberculosis. The disease has been called serous phthisis.

A.—OF THE PLEURÆ.

The indications of previous inflammation, and of the various pathological appearances common to serous membranes in tuberculosis, are met with after death, upon the whole more frequently in the pleuræ than in any of the other membranes. They occur much more frequently in tuberculosis than in other chronic diseases.

1. *Adhesions*—were found by Louis in 111 out of 112 subjects; there was but one case wherein the chest was free in every point. There are two varieties at least of these adhesions. One, commencing at the apex and gradually descending to the base of the pleural cavity, following the course of the tuberculous development, is the result of limited chronic irritation rather than inflammation, and consists of stratified layers of areolar tissue, uniting the pulmonary and costal layers, accompanied by thickening and degeneration of the corresponding portions of the pleura, and complete blending of the pulmonary with the costal surfaces by which a passage is often made for the intercostal and other vessels into the diseased lung; this constitutes for the most part the old adhesions of chronic phthisis. Patches of adhesion of this nature, the consequence of a slight irritation in a tuberculous state of the blood, and formed insidiously, never contain tubercle, but the irritation upon which they depend may amount to true inflammation more or less rapidly overspreading the pleura, and resulting in the various products of pleuritis modified by the tuberculous state of

the blood. Adhesions, the result of decided inflammation, constitute the other form, and every degree of blending of these two forms may occur.

Adhesions generally correspond with cavities in the lungs—their extent and firmness, and the amount of disorganization of the lung, bearing a direct proportion to each other. Sometimes they are easily torn, and are limited to a small space, the cavities in the lungs being of small dimensions or not existing; at other times, as indicated above, they consist of condensed structure corresponding with large cavities. The adhesions indicate the great tendency of the pleural membrane in tuberculous subjects to irritation and inflammation, and in this respect they are of great practical importance, but the *post mortem* appearances in a vast majority of instances show clearly the primary influence of the disease of the lung, especially where cavities are formed, in producing the inflammation upon which the adhesions depend.

2. *The Pathological Effects of Acute Pleurisy.*—These are very common in tuberculosis pulmonalis, and frequently cut existence short before the natural termination of the blood disease. This local affection is common to other chronic maladies, and particularly to blood diseases—acute and chronic—but occurs by no means so frequently as in tuberculosis. Louis noted it in one-tenth of his cases. It often occurs towards the close of life when the emaciation and debility have nearly reached their maximum; hence, effusion is found which has sometimes taken place very rapidly immediately before death. This is sometimes clear, at others a turbid, reddish, gelatinous or purulent fluid, and it gives rise to every variety of false membrane. These effects of acute pleurisy differ greatly from the mere local process above described, upon which the adhesions mostly occurring at the apex of the lungs depend. The effused gelatinous fluid frequently presents dull points, which become tubercular granules as large as pins' heads, and the plastic substance deposited from fibrinous or purulent effusion may contain tubercular granules.

3. *Tubercle.*—Another important pathological fact in this section is the deposit of tubercles in the pleura. By some observers it has been affirmed that they are never primarily deposited either in the substance of the membrane or in its subjacent tissue. Louis found grey granulations on the attached surface of the costal pleura, but he believes that they never assume this site without

being present also, and, indeed, without having been previously deposited in the lungs. Other observers have met with different results. In 312 children, Rilliett and Barthez met with one or two in which the pleura *alone* was tuberculous,* and in seven cases they found the pleura tuberculous to a great extent, no other organ containing more than a very inconsiderable quantity of the deposit; the pleura was tuberculous without the lungs being so in ten cases, and independently of the bronchial glands in six cases.

The false membranes covering the costal and pulmonary pleura sometimes contain tubercles, as before stated; or are converted into tubercular matter. Laennec observed this, and Hodgkin describes a false membrane lining the cavity of the pleura as being sprinkled with small opaque miliary tubercles which were apparently seated on the serous membrane. These membranes and the morbid deposit are generally of moderate consistence; but in one case Louis detected a semi-cartilaginous false membrane investing the apex of one lung, and presenting the tubercular transformation.

The most important question respecting the tuberculization of these false membranes remains. Fournet has affirmed that he several times met with miliary granulation in their substance, while the subjacent lung contained not a trace of such product, or presented simply a few granulations or slight tubercular infiltrations of its peripheral substance. He also saw a large cavern in false membrane similarly situated, while there were only a few traces of commencing excavation in the pulmonary tissue; and he has known the tubercular deposit to advance from the false membrane outwards and affect the sub-costal cellular membrane only. Under these circumstances, the lung opposite, uninvested with false membrane, occasionally remained perfectly free from tubercle. From these alleged facts he confirms the conclusion which flows from the above facts quoted from Rilliett and Barthez, that tuberculization of pleuritic tissue may occur, contrary to the rule laid down by Louis, independently of pre-existing pulmonary disease—may, in fact, be primary, and induce this morbid process consecutively in the lung; and this author's observations tend to prove that a similar mode of transmission from the serous membranes to the subjacent structures occasionally prevails in the intestines and brain. The soundness of his views has been disputed;† but if they should ultimately prove true, they will justify

* Lib. cit., p. 49 et 52. † British and Foreign Review, vol. ix, p. 325.

the establishment of a variety of the disease under the designation of tuberculosis pleuræ.

4. *Cicatrization and the Deposit of Cretaceous Matter.*—The curative tendency of tubercle has been observed in the pleuræ. At one or more points on the visceral layer of the membrane, especially at the summit of the lung, puckered cicatrices occur under whitish and radiated folds proceeding from a common centre and of variable depth. They derive their character from the retraction of the subjacent pulmonary substance, and thus resemble very closely scrofulous cicatrices on the surface of the body. Cretaceous matter is frequently deposited around them.

Dr. Padlini met with ossification of nearly the whole tract of the costal pleura, which at one place was cartilaginous and at another had the character of fibrous tissue, coinciding with a large pulmonary cavern. The case shews that the ossification as well as other morbid states of the pleura, depend on an altered state of the blood; calcareous and tubercular matter abounding therein. The author remarks, there was a morbid condition of the innervation and of the crasis of the reparatory fluid, giving rise to tubercles and ossification of the pleuræ.*

Carswell represents (Plate I, fig. iv, N.), from the lung of a cow, several tumours attached to the pleura pulmonalis both by a broad base and by slender necks; they are formed of a serous capsule containing tubercular matter; the pleura costalis, gall ducts, and omentum, being studded with similar tumours.

5. *Perforation of the Pleura.*—This occasionally occurs in tuberculosis, owing to the extension of a cavity from the lung, and gives rise to pneumothorax. This result, for the most part, is obviated by the intimate adhesions which have been described; but sometimes the adhesions are incomplete, and a small superficial cavity is followed by sloughing and destruction of the pleural coverings. The resulting perforations are never large, they have mostly a narrow fissure of an oval form and a dirty yellowish or greyish texture, which tears under the slightest pressure. They are generally situated in the neighbourhood of the third or fourth rib, and somewhat laterally, in the direction of the axilla. For the most part a fatal result rapidly follows this accident, and all the signs of violent pleurisy are met with: viz.—granulation of the whole serous surface, with a greyish tint, and very soft purulent

* Dict. Class. de Med., tom. xlv, p. 343.

fluid, dirty yellow purulent false membranes, and accumulation of gas; the lung is always compressed to the utmost, unless kept permanently distended by adhesions. Near the perforation the effort of nature to repair the injury by coating the part with coagulable materials is very evident; and when the fatal issue is delayed, (which in one case under my own eye happened for two months,) the perforation is surrounded by adhesions confining the mischief within narrow bounds. (Vide Hasse, p. 337.) Empyema is sometimes the result of perforation and sometimes pure liquid pus forms in great abundance; frequently, however, it is mingled with coagulable substances which become deposited on or loosely adhere to the pleura, or float in the collected fluid as soft flakes or pellets and resemble the fluid of an ordinary scrofulous abscess. The pus sometimes becomes sequestered within strong false membranes, the patient surviving for a long period, and ultimately dying of the general tuberculosis rather than of this local affection. In illustration of extensive exudation of tubercular matter from the surface of the pleura, Laennec reports a case from M. Cayol, in which the entire cavity on the right side of the chest was filled with pus.

Sir J. Clark gives an interesting account of a perforation of the pleura being the result of the tearing of an adhesion from its attachment immediately over a very small tuberculous cavity in the lung. Sir James explains the case after Dr. Carswell as follows:—After an attack of pleuritis, effusion had taken place to the extent of twelve or fifteen ounces; this, by separating the pulmonary from the costal pleura, produced a partial rupture of the cellular tissue constituting the adhesion, which had become elongated to the extent of an inch between the two pleuræ, and was kept in a state of tension. In this state of the parts, the force of the cough tore through the pleura at the edge of the adhesion, and thus produced the perforation.*

6. *Melanotic matter.*—Andral has observed black masses resembling melanotic tumours on the surface of the pleura.†

7. *Tubercle in the Pleuræ in children.*—No pathologists have more closely investigated the special pathological anatomy of the pleura in tuberculosis than Rilliett and Barthez in the cases of children who fell victims to the disease; they detected it on both surfaces, and hence describe intra and extra pleural tubercles.

* Cyclop. Prac. Med., vol. iv., p, 304. † Clin. Med., p. 235.

Intra-pleural Tubercles.

1. Grey granulation occurs occasionally in the cavity of the pleura, and in one case this was the only kind of tubercle. 2. They describe flat and lenticular yellow granulations, adhering more or less intimately to the internal surface, with a minute false membrane, at first secreted around the deposit, and afterwards between it and the pleura, so that the inflammatory product raised the granulation, and conveyed the idea of having secreted it; but the tubercle at other times exists as a foreign body, without any trace of inflammation. At other times, the pleura was covered with false membrane deposited in layers, each containing a considerable number of granulations; but, on raising the last layer, entire, small, perfectly isolated granulations were left in contact with the pleura, without any false membrane. These pathologists state, that in a majority of the cases the tubercle has not been formed in the false membrane, but anteriorly to it; in rare cases, false membrane and old adhesions contain tubercle, but this can only occur when, to a certain extent, the membranes have become organized. The yellow granulation tubercles are identical with those of the lungs, differing only in being in general flattened, although spherical ones have been met with. The false membranes surrounding pleural tubercles are vascular, but the vessels never penetrate the tubercles. The pleura subjacent to the granulation generally maintains its polish and transparency; sometimes a small circular depression is formed by the tubercle, occasionally it becomes opaline, and occasionally softens. 3. Miliary tubercles and patches of tubercular matter, resulting from a great number of the miliary tubercles uniting, are sometimes met with in the pleuræ. They are analogous to amorphous tubercular masses in the lungs.

Intra-pleural tubercles in children are generally dry and of a firm consistence; Rilliett and Barthez never saw them softened, or forming vomicæ, or perforating the serous membrane.

Extra or sub-pleural Tubercles.

These are developed under the pleura, between it and the tissue which it lines, but those only which occur under the parietal pleura are recognized under this head; those occurring between the pleura and the lungs being in reality pulmonary tubercles. They are sometimes round, sometimes flattened; the latter sometimes

project, and sometimes do not project, into the cavity. Round sub-pleural tubercles are most common in those parts of the membrane which adhere by cellular membrane most loosely to the subjacent tissues, as, for instance, on the anterior and posterior parts of the thorax. They form a series of round or ovoid tumours, which may compress the lungs on one aspect, or come into contact with the osseous or cartilaginous portions of the ribs on the other. Tubercles here are generally in the form of yellow infiltration or the miliary variety, rarely yellow granulation, and never grey granulation. In this latter respect they contrast with intra-pleural tubercles. They may soften, form caverns, perforate the pleura, and penetrate into its cavity, or communicate with pulmonary tubercles. The cavities may increase in size, being seated between the pleura and the intercostal muscles, or the denuded and partially destroyed ribs, forming irregular anfractuous caverns, sometimes running into each other, and containing pus and softened tubercular matter; the costal pleura ultimately becoming perforated, and the tubercular matter, originally contained in the cavern, discharged into the pleural sac. This is, however, a rare occurrence. Sometimes adhesions take place between the two pleuræ; and, again, the extra-pleural cavern may have a communication established with the lungs by a large perforation through the pulmonary pleura, the latter being ulcerated from within outwards; or a pulmonary cavern may serve as a medium of communication between the external surface of the costal pleura and the bronchi.

Tubercles in the pleuræ of children are generally deposited on both sides of the chest; when otherwise, they more frequently occur on the right side than the left; but extensive pleural tuberculization is almost always unilateral, and it is a very rare circumstance to find intra and extra pleural tubercles at one and the same time.

Perforation is by no means infrequent *in children*. 1. As in the adult, it may exist in connexion with a cavity, and may be the result of the gradual breaking down of its parietes. 2. It may result from the union of ganglio-pulmonary sub-pleural tubercular masses. 3. It may depend upon the rupture of an emphysematous bulla. In general the lung is compressed against the vertebral column; at other times it is maintained forwards or backwards by adhesions, and these adhesions may limit the space

containing the extravasated air. Sometimes there is no liquid effusion in the pleura after perforation, and an absence of any other sign of inflammation of the serous membrane. More frequently, however, there is an admixture of air and sero-purulent or purulent liquid in variable quantity. The gas is always free from odour, and, when the perforation has been of long standing, its seat can no longer be determined, adhesions existing which have closed the opening.

Rilliett and Barthez remark, that when the pleura is perforated in consequence of the progress of an extra-pleural vomica, the lung itself being sound, the tubercular matter may be evacuated, and, if the disease be of limited extent, a cure is not impossible (p. 330). A cure is still more probable if the sub-pleural tubercle, instead of traversing the lung, communicates directly with the bronchi. A case of this kind occurred in which a tubercular mass having perforated the costal pleura under which it was originally seated, was connected with the root of the lung and with the bronchia of the inferior lobe; an adhesion had taken place between the periphery of the pleural ulceration and the pulmonary pleura, and then the tubercle softened; then destroying the adhesions, a depression the size of an almond was produced in the lung, the base being formed by a kind of fibrous tissue which appeared continuous with the pulmonary pleura, without any direct communication with the lung; the bronchia which stretched along another part of the surface of the cavity was perforated in two places from without inwards; thus a vomica existed in the pleura which communicated with the bronchia without the intervention of the lung.

In the progress of general tuberculosis the affections of the pleura are of the highest importance, as frequently cutting short the blood disease by a prematurely fatal result.

B.—OF THE PERICARDIUM.

This membrane forms no exception to the other serous membranes in its habitudes in tuberculosis, but it is by no means so frequently affected as the pleuræ, or the peritoneum. The results of tuberculous pericarditis are occasionally met with, but adhesions and false membranes are rare. Louis found the pericardium adherent in two only of 123 cases of phthisis. Hasse, however,

describes tuberculous pericarditis; either a turbid grey liquor, more or less thin, is at the outset discharged into the sac, whilst the free surface of the pericardium becomes the seat of plastic deposit, consisting of greyish-white or faint yellowish, flat, tolerably firm aggregated granules of an undoubted tubercular character; or else a number of greyish-white granules, as large as a pin's head, congregate in the midst of plastic effusion, and continue accumulating; and whilst the organized portion of the effused fluid is effecting an adhesion between the heart and pericardium, these granules form into greater or smaller masses of tubercle, which, after absorption of the fluid parts, may assume a mealy consistence; but in all such cases, tubercles of older date are found in other organs.*

Tubercle may be deposited either in or under the pericardium. Baillie met with one case in which two or three "scrofulous tumours" grew within the cavity of the pericardium, one nearly as large as a walnut; they consisted of white, soft matter, somewhat resembling curd or new cheese. Louis mentions a case in which some semi-transparent granulations were seated under the serous laminæ, and were probably the exciting cause of pericarditis. Tuberculous pericarditis may also extend from the pleura in tuberculous pleuritis. Louis never met with tubercle or grey granulations in this membrane without finding a certain number in the lungs. When tubercles are developed in the pericardium, they will most likely produce death, although the lungs should contain few or none.

In children, according to Rilliett and Barthez, tubercles in the pericardium are not so rare. They found them ten times in 312 individuals, but twice only to any great extent. The most frequent form was miliary tubercle seated under the visceral fold; they are for the most part very small, but occasionally, especially when the pericardium does not adhere very firmly to the heart, they attain a larger size, even that of an almond. As in the pleura, once developed, they produce chronic inflammation with tubercular false membrane. These pathologists refer to a case in which the tubercular masses on the visceral subserous tissue gradually penetrated between the fleshy fibres, and some of the tubercles were on the point of penetrating the endocardium; hypertrophy of the heart was one of the results, and the two surfaces of the

* Lib. cit., p. 117.

pericardium had adhered by inflammatory action, forming a resistance to their progress externally.

C.—OF THE PERITONEUM.

The affections of the peritoneum in tuberculous subjects are closely analogous to those of the pleuræ. We meet with the anatomical results of simple chronic inflammation, and of acute inflammation, either with or without the deposit of tubercle. We also meet with the deposit of tubercle, which, in its more independent form, has been denominated peritoneal phthisis, and with all the consequences of this deposit passing through its several phases and acting as a foreign substance in or upon the serous membrane. Hence there are several distinct forms or varieties of tuberculosis arising from the localization of disease in the peritoneum.

1. *The Pathological Effects of Peritonitis.*—Chronic peritonitis frequently occurs in tuberculous subjects, as does chronic pleuritis, independently of the existence of tubercles; bands of adhesion constituting its especial anatomical element. When limited to the diaphragmatic surface these adhesions present characters similar to those of the pleura. When seated among the convolutions of the intestines, the folds of these become adherent. Serous effusion is also one of its most common results, the effusion presenting all the characters already described. Those portions of the peritoneum which invest the liver and the spleen in many cases become implicated with the pleura in tuberculous pleuritis; but in a minor degree, producing little other effect than adhesion. In a case of chronic peritonitis in a tuberculous subject, resembling the cases described by Sir H. Marsh and Dr. Churchill, I once removed at least two gallons of pus from the peritoneal cavity. These cases of an undoubtedly tuberculous or scrofulous nature, although by no means necessarily fatal, occasionally prove so without the deposit of a single tubercle in the lungs or elsewhere.

Acute or subacute peritonitis is also a very common affection in tuberculous subjects; for the most part it occurs consequently to the deposit of tubercle, but sometimes independently. Like acute pleuritis, it sometimes sets in a few days before the fatal termination of extreme tuberculosis. It sometimes, also, by one or other of its pathological consequences, cuts short tuberculosis before this disease has produced its extreme effect on the vital tissues and exhausted the vital powers of the system.

Chronic peritonitis becoming more or less acute, has frequently also a great share in hastening the termination of tuberculosis; where it exists the disease sometimes runs its career very rapidly—in one of Louis's recorded cases in 44 days. It may coincide with chronic pleuritis.

2. *Tubercle.*—Baillie was one of the earliest to describe the deposit of tubercle in the peritoneum. He states, that he several times had opportunities of observing a white, soft, granulated matter adhering universally behind this membrane; in some places it formed a mass of considerable thickness; in others it was scattered in single small masses; in one place it formed a substance as thick as the hand, deposited between the peritoneum and the abdominal muscles, while it was scattered in small separate portions in the mesentery and the peritoneum covering the intestinal canal; the omentum was sometimes charged with a cell-like substance; the matter exactly resembled the structure of a tuberculous absorbent gland before pus is formed.

The deposit sometimes takes place primarily in the peritoneum, this membrane being the first part, and, in rare cases, the only part attacked. It leads, for the most part, to deposit in the external glands (Rokitanski); and, in the female sex, to tuberculization of the uterine and vaginal mucous membrane. Tubercle of the peritoneum, particularly the granulated variety, rarely passes into the stage of softening, and still more rarely into that of cretification. It frequently becomes stationary. In three cases of children Rilliett and Barthez found the peritoneum tubercular to a great extent, no other organ containing more than an inconsiderable quantity.

But tubercle in this, as in other serous membranes, occurs much more frequently after it has been deposited in another part. Hence it is associated with pulmonary, intestinal, and cerebral tubercle. Acute peritoneal tuberculosis, with deposit of tubercle, is also usually complicated with a corresponding affection of the spleen, the liver, and the kidneys.

Carswell observes that the grey semi-transparent substance is generally more abundant than pale-yellow opaque matter, and a nucleus of the latter is frequently enclosed in a considerable quantity of the former, hence the deposit of this grey matter certainly precedes the formation of yellow matter.

Tuberculization of the peritoneum is frequently circumscribed,

and limited to parts which correspond with tuberculous ulcers of the mucous membrane. In this case the deposit does not take place until the tubercular infiltration has extended from the inner surface of the intestinal canal through the muscular coat to the peritoneum itself; the membrane becomes injected and covered with purulent exudation in the part corresponding with the deeply ulcerated mucous membrane. Sometimes this inflammation extends to another portion of peritoneum belonging to a knot of intestine lying in contact with the ulcerated one; adhesion may form between the two parts, and, if the ulcer should perforate, the adhesions form a barrier to circumscribe the effusion.

Adhesions may occur in any part where tubercle is deposited, agglutinating the viscera together. Louis found partial and general adhesions of old standing the result of previous chronic peritonitis. The muscles become affected in the neighbourhood of tubercular deposit in the peritoneum in a greater degree than in ordinary peritonitis. In the intestinal coats they are pale and friable, easily lacerated and broken up, and the abdominal muscles waste and lose colour.

Great differences result from the site of tubercles of the peritoneum, according as they occupy the internal or external face of the membrane. Even when extra-peritoneal they occasion loose adhesions between the folds of the membrane by which nooses of intestine are sometimes glued together. Where tubercular patches occur, the adhesions may be more solid, fibrous and resisting. These adhesions form a useful barrier against perforation. Intra-peritoneal tubercles have no tendency to perforate; extra-peritoneal tubercles have always that tendency.

3. *Peritoneal Tuberculization in Children.*—In children, grey and yellow granulations, miliary tubercles, patches of tubercle, and crude and softened yellow tubercle, occur thus:—

Grey granulation is more frequent than in the pleura. In the omentum it is sometimes in round grey semi-transparent masses similar to those of the lungs, and it may be observed contained within the folds without any appreciable alteration of the membrane itself. The fine vascular net-work which sometimes surrounds without in any instance penetrating the tubercle, is more apparent here than elsewhere. The form which grey granulation assumes in the serous membranes depends upon mechanical causes. It is sometimes hard, resisting, and cartilaginous. It is some-

times seated on the internal, but much more frequently on the external surface of the membrane.

Yellow granulation is more common than the former; it is almost exclusively located on the internal surface, and mostly surrounded by a false membrane, the existence of which it precedes. By means of these granulations and the false membranes which surround them, tubercular adhesions of the liver or the spleen to the diaphragm are formed.

Miliary Tubercle and Tubercular Patches may be intra or extra-peritoneal. The patches are seldom larger than almonds. In a small number of cases tubercular deposit in the omentum, or even between the parietes of the abdominal organs, is much more abundant, and is then usually aggregated into enormous masses.

Grey infiltration appears to be a very rare occurrence in children. Rilliett and Barthez found the sub-peritoneal surface of the pelvis in one case sprinkled with a kind of fine *dust* (*poussière*), formed of small ovoid yellowish-white grains, soft, non-adherent to the peritoneum, and of which it was difficult to determine the nature.

And, just as extra-pleural tubercles sometimes establish a communication between the interior of the air passages and the pleura, so extra-peritoneal tubercles in rare cases establish a communication between the digestive passages and the peritoneal cavity. The tubercle softens, produces ulceration of the intestinal tunics, and, as it progresses in every direction, on the one hand it destroys the serous membrane and on the other the mucous membrane from without inwards; in this way an ulceration of the digestive canal is produced differing from that which results from softening of intestinal tubercles; and in this way also, extravasation of the contents of the intestines into the peritoneal cavity, and its rapidly fatal consequences may occur.

An ulcer in the intestine proceeding from an extra-peritoneal tubercle appears in the form of a round aperture, with a projecting loose edge, as if made with a punch, and without any trace of inflammation of the surrounding membrane; the detritus of softened yellow tubercle may be sometimes observed at its base.

On destroying slight adhesions which unite nooses of intestine, a small cavity is often found between them, the walls of which are formed by the muscular tunics, and by the united edges of the ulceration of two contiguous peritoneal folds; the tubercular

matter lying naked on the muscular coat of the intestine. In a more advanced period, the tubercle is found softened, suppuration having occurred and destroyed the muscular coat; the cavity being closed on one side by the mucous coat; and in the last stage this becomes perforated; the fæcal matter, should the peritoneal adhesions not be very firm, passing into the serous cavity. The tubercle forms a tumour towards the intestine from the size of a millet-seed to that of a pea, and the muscular coat may in the first place be perforated while yet pale and without a trace of inflammation, giving passage to tuberculous pus.

Sometimes a direct communication is formed between distant parts of the digestive tube, and alimentary or fæcal matters pass from the superior to the inferior portion without traversing the intermediate space. In such cases adhesions have been formed between two contiguous faces of the serous membrane, tubercle softening and perforation of the serous, muscular, and mucous coats is the consequence.

In children, also, sometimes numerous tubercles connect the intestines with the abdominal parietes, or the liver and spleen with the diaphragm, the whole abdomen being affected. Sometimes, on the contrary, the tuberculization is more limited, occupying circumscribed spots only of the serous membrane. Partial, is much more frequent than general tuberculization; it is met with in a majority of cases in the superior portion of the abdominal cavity, and particularly on the inferior surface of the diaphragm; after the diaphragm, the omentum is its most frequent seat; it is rarely observed between the folds of the intestines or in the pelvis. Sometimes the abdominal walls are free from adhesions; at other times adhesions occur throughout their extent. Finally, in children tubercle is more frequently intra than extra membranous; of all the forms yellow granulation is the most common; after this miliary tubercles, combined or not with tubercular patches; grey granulation occurs frequently; and, as in the adult, peritoneal tubercles rarely soften.

In 86 cases of peritoneal tuberculization in children, Rilliett and Barthez found:—

Grey granulations	24	Tubercular dust (*poussière*)	1
Yellow „	43	Intra-serous tubercles	40
Miliary tubercles united or not into tubercular patches	37	Extra serous „	22
Softened tubercles	6	Intra and extra serous tubercles together	14
Grey matter in masses	2	Seat doubtful	10

Tuberculization of small amount	42
Tuberculization rather abundant	24
Tuberculization abundant	20*

4. *Melanotic Matter.*—This is met with occasionally in the peritoneum, in cases of chronic tuberculous peritonitis. The tubercles scattered over the peritoneum are surrounded by a dark ring, or by a multitude of minute vessels, filled with black blood, either grouped closely together, or having a stellated arrangement; the tubercles, if small, being thereby greatly obscured, and the peritoneum appearing as if spotted with a deep brown or black pigment (Carswell). Peritoneal false membranes may also be stained black or infiltrated with melanosis (Andral). Cases have occurred in which the whole surface of the peritoneum, being free from adhesion, was covered with a thick false membrane strewed with infiltrated melanotic matter containing myriads of yellowish tubercles.†

Rokitanski remarks, that tubercle formed on serous membranes is frequently a hæmorrhagic production occurring in a state of congestion; he believes that this tendency to hæmorrhage depends upon the qualities of the blood in relation to its fibrine, and upon the deposition of tubercle tending still further to impoverish the blood of fibrine. He states also, that this hæmorrhagic production of tubercle is sometimes the result of primary inflammation of a serous membrane, but much more frequently a product of a secondary inflammatory process occurring in a plastic exudation, promoted by the imperfect formation of their blood-vessels. It occurs in other chronic diseases, but much less frequently than in tuberculosis. It takes place repeatedly, and at intervals, the blood exuded being very much altered in composition, and partaking of the qualities of tuberculous blood; and it frequently co-exists with tubercle in the same exudative substratum.‡ These remarks have to be associated with the facts relating to melanosis.§

5. *Tubercle in False Membranes.*—The occurrence of tubercle in false membrane, as described by Louis and Rokitanski, is most interesting and important. In one case a great number of semi-transparent miliary granulations were met with in the substance of an imperfectly opaque false membrane, deposited on the free

* Path. Anat., Art. Tubercle.

† Comp. de Med. Prac., tom. vi, p. 387, by Monnoret and Fleury.

‡ Path. Anat., vol. iii, p. 17.—Syd. Ed. § Vide ch. iii, p. 156 of the present work.

surface of the peritoneum and in the great omentum; they came away with it when it was removed. In another case there were patches of tubercular matter between the contiguous layers of a false membrane investing the intestines and the anterior wall of the abdomen. In another case there were masses of semi-transparent grey matter in the midst of a large quantity of tubercular deposit accumulated in the omentum and mesocolon; *with tubercle in the lungs and mesenteric glands not more advanced than in the peritoneal duplications.* In several cases subsequently met with the folds of the peritoneum were transformed into grey semi-transparent and tubercular matter. The following facts are also most interesting. Tubercular granulations in the false membrane do not all stand in the same relation to the peritoneum. In the greater number of cases the tubercle and false membrane were removable together. In two instances the tubercle remained adherent to the peritoneum when the false membranes were separated. In one case, where the false membranes contained no tubercles, there were, in certain places *between them,* lamellæ of tubercular matter, "as if the false membranes had acquired by semi-organization the faculty of secreting this matter." When tubercle occurs in the products of inflammation here as in other parts of the body, the inflammation must not be mistaken for the cause of the tubercle; the tuberculous state of the blood upon which the inflammation has supervened, or which may have set itself up in the progress of the inflammation, is the cause of the tubercular deposit.

Dr. Carswell also makes some important remarks respecting the deposit of tubercle in the peritoneum. Admitting that tubercle is formed from tuberculous blood, it is obvious that when the deposit occurs on a secreting surface the latter may nevertheless be healthy; and a healthy secreting surface may separate from the blood both the materials of its own peculiar secretion and also those of tubercular matter. The natural secretion of the peritoneum being increased, and containing a quantity of tubercular matter mixed up with it, tubercle is after a time separated as a heterologous secretion. In tuberculous peritonitis the three following stages of the process of tuberculization are frequently well marked:—

1st. On one portion of the membrane there is seen a quantity of recently secreted coagulated lymph. 2ndly. On another portion we find the same plastic semi-transparent substance partly organized, and including within it, or surrounding, a globular mass of

tubercular matter. 3rdly. On another part the coagulable lymph is found converted into a vascular or pale areolar tissue, covered by an accidental serous membrane, beneath which and above the peritoneal or original secreting surface the tubercular matter is seated, having the form of a round granular eminence, resembling pale, firm cheese in colour and consistence.

In Plate III, fig. 4 of the "Pathological Anatomy," the deposit of tubercle in false membrane is beautifully represented by Dr. Carswell. The false or accidental cellular coat, becoming a false serous membrane, covers the peritoneal coat of the intestine, and tubercles are distinctly seen in the false cellular membrane, and also in the areolar texture between the circular fibres of the muscular coat beneath.

Rokitanski found yellow cheesy matter, sometimes shapeless, sometimes as large as doves' or hens' eggs in the accidental "cellulo-serous" tissue.

Another important consideration in relation to the blood disease is that an inflammation of these membranes may take place, during which the exudation is at first perfectly free from tubercle, but while the inflammatory exudation is organizing, it may become the nidus of tubercle; in other words, the blood may at first be so little tuberculous that it forces out an organizable material; but while this is taking place, if the blood-disease become aggravated, a tuberculous blastema may be blended with or supersede the original plastic exudation. More than this—the healthy exudation itself, having become partially organized, may supply a new exudation which shall be tubercular. Thus, a serous membrane is sometimes lined with an exudation, the outer and older layer of which is free from tubercle while the inner is tubercular, and the tuberculous qualities of the blood increasing, tubercles may be deposited from the vascular centres which are forming in the false membranes.

D.—OF THE ARACHNOID MEMBRANE.

This membrane, the natural anatomical relations of which differ from the other serous membranes, differs also in its pathology, but it forms no real exception to the other structures in its morbid conditions in tuberculous subjects. They are, however, for the most part seated in the loose subjacent areolar tissue of the pia mater; and some of the best pathologists refer them altogether to

the latter membrane. They consist in, or they occur independently of, or consequently upon the deposit of tubercle, either in the membrane itself, or in the substance of the nervous masses. They are comparatively of rare occurrence in adults, but very frequent diseases in childhood, the tuberculous condition of the blood, whether from structural development or functional causes, being much more prone to localize itself here during the earlier periods of life than subsequently.

The tuberculous pathology of the meninges, both in the adult and in children, consists in—induration, adhesion to the substance of the brain, opacity, thickening, simple effusion within or under the arachnoid membrane, the products of acute or chronic inflammatory action—or infiltration of the meshes of the pia mater with plastic and fibrinous lymph, sero-purulent fluid, or concrete pus, often following the course of the blood-vessels, or with transparent fluid containing albuminous flocculi. These appearances present themselves either with or without the deposit of tubercle. The arachnoid, like the other serous membranes, is liable to acute inflammation during the closing days of existence, when emaciation and debility have nearly attained their maximum.

Tubercle.—Baillie believed that he detected tubercles in the arachnoid in the adult. Hodgkin remarks, that they are very rare. Louis describes, as an occasional occurrence in adults dying of phthisis, "arachnoid granulations" or rounded bodies, opaque or slightly transparent, varying from the size of a millet-seed to that of a pea, springing from the upper surface of the cerebral arachnoid, and sometimes presenting through the upper surface of the dura mater, this membrane having the appearance of being slit to receive them; sometimes isolated, sometimes grouped together, generally seated near the longitudinal sinus, the membrane being more or less thickened and opaque wherever they existed. But even by Louis these granulations were met with more frequently in young subjects than in those who had died at a more advanced age.

Rokitanski appears but rarely to have met with tubercles in the arachnoid, and he scarcely ever saw them on the free surface; he states that, unlike the other serous membranes, morbid exudations are at all times very rare.

The tuberculous pathology of the membranes of the brain has been much more completely studied in early life, during which

tuberculous affections, both of the brain and its membranes, occur infinitely more frequently than in the adult.

Tuberculous Affections of the Arachnoid Membrane and Pia Mater in Children.—The tuberculous pathology of the meninges in children is deeply interesting, and we owe the greater part of our knowledge of it to M. M. Rilliett and Barthez, Dr. Hennis Green, M. Piet, and a few others.

(*a*) *The Results of Inflammation.*—There is every ground for the belief that in tuberculous children, independently of the deposit of tubercle, the membranes are extremely prone to inflammation; and hydrocephalus is, in perhaps a majority of cases, a tuberculous meningitis, analogous to the tuberculous pleuritis or peritonitis, already described, either without the anatomical element, or with it, being one of its effects. The habitual seat of the inflammatory products is the pia mater. The arachnoid is but secondarily and slightly affected, its cavity sometimes containing a small quantity of limpid or turbid fluid, with a gelatinous coating, and pus very nearly concrete is found within it. The pacchionian glands are frequently enlarged and project into the serous cavity, and the membrane around them is opaque more frequently than in other diseases of infancy; sometimes the arachnoid is more generally opaque and thickened—over the whole of a hemisphere or the whole base, for instance. The true effects of inflammation are found, however, in the pia mater, from simple congestion to the most extensive and abundant suppuration; from simple infiltration of a limpid liquid to that of a greenish and gelatiniform substance. Sometimes the meshes of the pia mater are thickened, indurated, red, brittle, moist, and exude on pressure a bloody fluid, constituting a true acute inflammatory turgescence; sometimes the membrane is thickened and indurated, but whitish, resisting to the finger, with difficulty torn, and exuding no liquid on pressure; a chronic condition mostly found around tubercles which have been deposited. At other times a true concrete pus or a pseudo-membranous exudation is found. These products occur incomparably more frequently at the base than at the upper part of the brain, and it is very rare to find them limited to the summit, while they are very frequently limited to the base. The pathological effects of tuberculous meningitis differ from those of common meningitis in the pus being concrete and very rarely liquid, in being seated most frequently at the base, in being for the most

part limited to the anfractuosities when it occurs on the convexity, and in invading almost exclusively the pia mater.*

Different opinions have been entertained as to the amount of fluid in the brain, and more particularly in the ventricles which ought to be deemed morbid. Andral lays it down as a rule that before the quantity of cerebral fluid in the cavities of the brain can be regarded as morbid, it must exceed an ounce. In 60 cases of cerebral tuberculization noted by MM. Charpentier, Gherard, and Piet, 25 times it did not reach this quantity, and in many it was much less; in 27 cases it reached two ounces or more, and in two cases about three ounces. The fluid is rarely seated in the great arachnoid cavity. Sometimes it is found more abundant in one ventricle than in the other. It most frequently infiltrates the pia mater, extending to the subarachnoid tissue of the base, the cerebellum, the annular protuberance, and the medulla oblongata. In some cases it is transparent, limpid, and resembles whey; at other times it is turbid, containing albuminous flocculi and whitish filaments, the detritus of the softened substance of the ventricles; an effect attributed by some to inflammation of the lining membrane of the ventricles, and by others to softening without the intervention of inflammation, and probably resulting from either or both of these causes.

(*b*) *Tubercles.*—In children as in adults tubercles in the membranes of the brain are much less frequent than in the pleuræ and peritoneum. This has been explained by their being very rarely developed on the internal surface of the arachnoid, and by the laxity of the areolar tissue of the pia mater and slight resistance of the brain, compared with the solidity and inextensibility of the cranial walls. Hence, also, they are developed in the pia mater. MM. Rilliett and Barthez detected but one case in 74 of tubercle within the cranial cavity, in which the deposit was located in the interior of the arachnoid cavity. In this case there were small, yellow, round, lenticular granulations on the internal surface of the dura mater at the bottom of the left parietal bone near the lateral sinus, similar to those which occur within the pleuræ.

The most frequent *forms* of tubercular matter are yellow granulation and miliary tubercle; grey granulation and tubercular patches are rare.

* Rilliett and Barthez, lib. cit., p. 482.

Granulations in the membranes of the brain are subject to variations in form from pressure, according to their seat, as in other serous membranes; they are sometimes so minute that they resemble the tubercular "*dust*" of the lungs, at other times they are nearly a tenth of an inch in diameter; sometimes they are so numerous that they cannot be counted, at other times one or two only can be detected on each hemisphere on the minutest investigation.

In their distribution they frequently follow the direction of the large cerebral veins, and in the anfractuosities of the brain they coalesce and form masses generally of a rounded form or sometimes flattened. They are also very frequently found at a distance from any very large vessel. When run into patches, traces of chronic or acute inflammation surround the tubercles, and granulations are sometimes disseminated in the morbid products, just as they occur in the tubercular patches of the pleuræ.

Miliary tubercles are almost always round, being only a little flattened at the point fronting to the dura mater; many develope themselves so as to acquire considerable dimensions, as of a pigeon's egg (p. 475); they are less numerous than granulations, sometimes one, two, or three only are found about the size of a pea; rarely more than 15 or 20 at a time. They sometimes coalesce and form an irregular mammillated mass containing portions of the pia mater more or less altered; as they develope themselves they sometimes become surrounded by a vascular zone, and subsequently a cyst forms at the expense of the pia mater. Rilliett and Barthez consider the surrounding vessels as undoubtedly of recent origin. When they press upon the dura mater, adhesive inflammation between the visceral and parietal folds of the arachnoid takes place, and in consequence, intimate adhesions with the dura mater are formed; these adhesions are rarely observed on the convex surface of the cranium, seeming to indicate that the weight of the brain had some influence over their production. In the direction of the brain, owing to its softness, the tubercle gradually depresses the substance until it is almost entirely surrounded, but it always maintains its relation to the pia mater with which it remains in contact; tubercles thus *imbedded in the brain*, are to be distinguished from tubercles of the *cerebral substance*.

Rilliett and Barthez found that 52 cases of meningeal tuberculization presented the following varieties:—

Granulations		42	Yellow granulation only	23
,, yellow	38		Grey granulation only	4
,, grey	9		Yellow and grey granulation	6
Miliary tubercles	17		Miliary tubercle alone	10
Tubercular patches	2		Miliary tubercle and granulation	6
Cretaceous tubercles	1		Patches and other tubercles	2
Softened tubercle	1		Cretaceous tubercles alone	1

The tubercular granulations are generally, while very small, whitish and opaque, rarely grey and semi-cartilaginous; after a time and in proportion as they increase in volume, they acquire a greenish or yellowish tint. The miliary tubercles or those which are round and tend to develope themselves towards the brain, as already stated, are removed with the pia mater, when this is detached from the brain, and a large number are then generally found hidden at the bottom of the convolutions.

The *seat* of tubercles in the membranes of the brain in children may be any part of the convex or plane surfaces of the hemispheres, in the lateral or median parts of the base, over the fissure of Sylvius or the cerebellum, but they are much more frequent on the convex surface than in the base. They are also much less frequent in the membranes of the cerebellum than in those of the cerebrum.

The external surface of the visceral layer of the arachnoid adheres closely to tubercles deposited in the pia mater and to the false membranes which surround them; the sac of the arachnoid sometimes presents evident traces of inflammation developed subsequently to the tubercle, consisting of a first or less advanced stage of the inflammation, characterized by dryness or a glutinous state; sometimes even when pus has been infiltrated into the pia mater. False membrane on the internal surface of the arachnoid, the result of inflammation from the presence of tubercle, is a very rare occurrence. Piet* met with it but once in 24 cases. Becquerel found in one case at the base of the brain, swimming in turbid serum, a soft gelatinous almost transparent false membrane, and in two cases thin but solid adhesions of the two folds of the membrane.† Other pathologists of extensive experience have met with the occurrence very rarely. The arachnoid and pia mater sometimes adhere to the cortical substance at the seat of tubercular deposit.

An intricate co-relation appears to exist between the production

* Sur la méningo—cephalite tuberculeuse des enfans, p. 33.

† Recher. Clin. sur la meningitis des enfans, p. 12.

of tubercles in the membranes of the brain and tuberculous affections of other structures and organs. It generally coincides with *incipient* tuberculization of other organs, and principally with that form of tubercle which occurs when the disease is acute; in such cases the tubercle both in the brain and elsewhere would appear to be acute. The mucous membrane of the stomach is frequently destroyed. MM. Charpentier, Senn and Piet found it so over a greater or less space 16 times in 60 cases. M. Rufz regards it as a constant secondary lesion. It is frequently seated at the large curvature; the three tunics in this situation are sometimes so soft that perforation occurs from the slightest traction. M. Piet found acute inflammation of the internal membrane of the intestines 18 times in 60 cases.

M. Guersant has stated that he knew but one exception to the rule that when tubercles occur in the brain they are met with in other organs, and that one may doubt if a corpuscle found in the pia mater is a tubercle when this is not the case. Other instances have, however, been recorded. MM. Fabre and Constant have recorded one case. Tubercles in the cerebral membranes were found to be complicated with affections of the substance of the brain 55 times in 82 cases. M. Piet found in 85 cases tubercles in the lungs 46 times; in the bronchial glands 40 times; in the mesenteric glands 24 times. In 75 cases tubercles in the spleen 46 times; in the liver 5 times; and in 87 cases tubercles in the costal pleura 16 times, and in the peritoneum 15 times.

In 87 subjects who died of meningitis 63 had tuberculization in different degrees in other organs besides the head. In meningeal tuberculosis the heart is generally found flaccid and its cavities contain fluid blood.*

It has been already stated that tubercles in the membranes of the brain are much more frequent at the convex surface than at the base, while inflammation of the membranes is incomparably more frequent at the base than at the convex surface; also, that tubercle and inflammation may exist independently of each other; sometimes tubercles occupy the membranes of one portion and inflammation those of another portion of the brain; when inflammation surrounds tubercles, in some instances, they bear a proportion in its intensity, but in an equal number the inflammation bears none

* Compend. de Méd. Pract., par Monneret et Fleury, tom. v, p. 617.

to the quantity or extent of the deposit; thus, even where inflammation and tubercles coincide, they have neither the same seat nor a proportionate intensity. Hence there does not exist any essential or necessary relation between the deposit of tubercle and the existence of tuberculous meningitis. The latter may be induced by the irritation of tubercle or by some other exciting cause foreign to the existence of tubercular deposit.

Rilliett and Barthez make the important remark, that when grey and yellow tubercles occur together in the membranes, some are of a yellowish grey, confirming the opinion of the transition from one variety to the other. They present themselves, in the first instance, as small transparent granulations in the meshes of the pia mater, which subsequently become yellow and opaque. The granulations frequently extend to the origin of the cerebral nerves, and we have seen that the interior of the ventricles are liable to become affected by contiguity.

In the adult, occasionally, and in children more frequently, tubercles are detected in the membranes of the brain when there have been no pre-existent symptoms. In these cases the membranes present either no traces of inflammation or unequivocal evidence of the previous occurrence of chronic or even acute inflammatory action. When there are no symptoms the deposit is usually on the convex surface, whereas, when the usual cerebral symptoms accompany the aggregation it is most frequently at the base. Cerebral tubercles without symptoms generally coincide with very advanced tuberculosis, the deposit having been made either in many organs or in one only; whereas, when cerebral symptoms have accompanied the local deposit, the tuberculization of other organs is generally recent and little advanced.

Tuberculous arachnitis is well illustrated by Cruveilhier. In the first plate of his tenth book he gives a most interesting case of "chronic sub-arachnoid meningitis" at the base of the brain in a girl eight years old; there was general tuberculosis with miliary tubercles in the lungs, liver, spleen, and some of the lymphatic glands; the ventricles were distended with serum, and there was a large layer of concrete pus and false membrane deposited in the sub-arachnoid tissue of the base, extending to the fissure of Sylvius. In another case of a boy, aged six years, there was inflammation of the sub-arachnoid tissue at the base of the brain, with pseudo-membranous exudation; the pia mater was greatly

injected, and there was adhesion of the arachnoid on the convex surface of the brain, at a point corresponding to a sub-arachnoid tubercle; the areolar tissue was infiltrated with serum and thick pseudo-membranous exudation; and, on exposing the fissure of Sylvius, there were a great number of whitish tubercles of different sizes appended to the vessels, or rather within the areolar tissue surrounding them.* In two of the cases of phthisis described by Louis in adults, there was thickening, opacity, and granulation affecting the central upper half of the membrane; and in two cases there were shreds of yellowish, extremely soft false membrane. In Case IX, described by Louis, the arachnoid was adherent to the dura mater above the seat of tubercle in the brain; and a similar occurrence is noted by Dr. Carswell. A considerable quantity of serous effusion resulting from the protracted death struggle and the impeded circulation was almost always accumulated beneath the arachnoid membrane and within the areolar tissue of the pia mater in Louis' cases of phthisis.

In another case described by Cruveilhier,† there was slight effusion on the convex surface, and considerable thick opaque effusion at the base, on the internal surface of the hemispheres, and at the bottom of several of the sulci; there were a number of tubercles which separated from the brain with the membranes, having compressed and indented the brain, and produced inflammatory softening. Most of these tubercles were hollow in the centre—the softening of the brain was evidently consecutive to the deposit of the tubercle. Cruveilhier believes these tubercles are formed very rapidly.‡

Mr. Robert Dunn has recorded a most interesting case of tubercular deposit in a boy, two years old, on the surface of the right hemisphere of the brain beneath the arachnoid and pia mater, occupying a superficies of about two inches square, in patches of irregular size and shape, the deposit being most abundant on the surface of the convolutions, but descending into the sulci between them.§ The cavity of the arachnoid was natural, and there was no sub-arachnoid effusion; the cortical substance of the brain in contact with the tubercular matter was reddened, softened, and otherwise disorganized; and a small portion of the subjacent white matter was softened. On the edge of the left hemisphere, corres-

* Lib. vi, pl. ii. † Idem. ‡ Liv. ii, p. 2.
§ Med. Chir. Transac., vol. xxv, p. 209.

ponding to the diseased patch on the right, a slight tubercular deposit had taken place in a similar manner.

Tubercles in the Spinal Arachnoid.—M. Papavoine met with a case.* M. Rilliett and Barthez with another.† All the observations referring to the seat of the deposit in the arachnoid of the brain are applicable here, but tubercles have been so rarely observed in this situation that very little is contained in authors upon the subject. The question arises whether this may not be attributable to the very frequent omission to examine the spinal cord.

(*c*) *Meningeal Apoplexy.*—Sanguineous effusion into the cavity of the arachnoid happens occasionally in tuberculous subjects, and for the most part in general acute tuberculosis with meningitis. It presents itself as a circumscribed extravasation of blood, and may be produced while tubercular deposit is taking place; tubercles in the brain or even in the bronchial glands sufficing for its production without any other cause. Occasionally it appears to have resulted from the enlargement and pressure of some of the abdominal viscera. The dura mater is healthy, the superior longitudinal sinus frequently empty, but sometimes contains small yellowish clots, the other sinuses of the brain are generally filled with blood and never obliterated. (Rilliett and Barthez). In one case a large tubercle in the brain coincided with and appeared to have occasioned a sanguineous effusion into the arachnoid simultaneously with a ventricular hydrocephalus.

I have collected the principal anatomico-pathological facts relating to the deposit of tubercle in connection with the serous membrane of the brain. Tubercle of the brain itself will be treated of in the section relating to tuberculization of the viscera, and I shall then again have to refer to the membranes. The facts in this section shew that the deposit may occur in the membrane covering either the brain, cerebellum, or spinal marrow; it is sometimes limited to a particular portion, as the base or the pons varolii; it may proceed from the sub-arachnoid tissue to the tissue between the sulci; and it may give occasion to numerous forms of tubercular disease, with peculiar symptoms, referrible to the nervous functions, and depending upon the precise local development of the blood disease. M. Nelotan exhibited to the Anatomical Society of

* Journal heb. t. vi, p. 113. 1830. † Lib. cit., p. 469.

Paris a specimen of tubercles deposited around the origin of most of the cranial nerves, the brain being quite healthy.

E.—OF THE TUNICA VAGINALIS TESTIS.

Inflammation in this membrane in tuberculous subjects, so far as it has been observed, has its starting point more frequently than even in the pleura and peritoneum in tubercular disease of the viscus which it envelopes. Tubercle is sometimes deposited in it, and it forms no exception to the other serous membranes, although comparatively it is rarely affected. Tubercle deposited in the testis is a very important disease, and will be considered in the morbid anatomy of the viscera.

In concluding this summary of the more important pathological facts relating to the condition of the serous membranes, when the seats of local disease in tuberculosis, it should be remarked that the effects of the disease of the blood are as closely analogous, not to say identical, in all these membranes, as the structural and physiological peculiarities and the particular site of each membrane would lead us to expect; and that, although both tuberculous disease and the deposit of tubercle are most frequent in the pleura, the peritoneum, and the pericardium, they may occur in any of the serous membranes, and have been observed in almost all, but in some, as in the spinal arachnoid, very rarely. Again, tuberculosis not unfrequently developes itself in nearly all the larger serous membranes at once, either in one and the same, or in various forms. In chronic cases granular deposit frequently originates, at one and the same time, at various points, gradually extending itself over a large surface, or over the whole membrane; but, owing to changes in the state of the blood, and other causes, its advance is for the most part not uniform: in the acute form the tubercles are generally evenly disseminated over the whole or a considerable part of the membrane, and are uniformly developed; but the acute frequently supervenes on the chronic form. Tuberculization of the serous membranes is again, in by far the greater number of cases, but one of those localizations of the blood disease which are taking place simultaneously or consecutively in various structures and organs. Dropsy of the serous cavities is another of the results of the deposit of tubercle; and, according to Rokitanski, this is directly proportioned in amount to the extent of the tuberculization

of the membrane; and the same pathologist remarks, that the œdema of the serous membrane and adjoining areolar tissues, the infiltration of the parenchyma with the serum of the blood, and the loss of its colour, as well as the thinness and defibrination of the blood, all correspond with the acuteness of the disease.

SECTION IV.

THE PATHOLOGICAL ANATOMY OF THE FIBROUS TISSUES IN TUBERCULOSIS.

The local development of this disease, primary or secondary, in the fibrous system, is a very rare occurrence; when met with, its precise seat is most probably the areolar and not the fibrous tissue. In the membranes covering bones inflammation gives rise to a tubercular product, which is deposited for the most part on the surface adjoining the bone; this product degenerates into a mass of caseo-purulent matter, which, being enclosed in a capsule of the fibrous structure, itself infiltrated with a lardaceo-gelatinous substance, loose pulpy swellings are formed; the disease advances by the progressive deposition of tubercular matter in the adjoining parts, as happens in other parts of the body, and destructive ulceration of the membrane, of the adjoining bone, or along the ligaments, forming sinous tracts, are the consequences. These sinuses may close and their contents become chalky.*

In the dura mater:—Tubercles may be deposited as above described, but they are most frequently found adhering to the inner surface, and are enveloped in the serous or vascular membrane, or the substance of the brain on the one hand; or, on the other hand, the dura mater may be the seat of tubercular deposit, or tubercular inflammation and suppuration, by extension from the cranial bones, when these have become carious from tubercular disease.

In the dura mater of the cord:—Inflammation and suppuration occur, and also tubercular deposit, but they appear to have been met with only accompanying tuberculous caries of the vertebræ (Pott's disease), or tubercle deposited in the substance of the vertebræ and projecting upon the dura mater.

In the periosteum.—Tubercle occurs in the periosteum, but this will be treated of in connection with tubercle of bone, and the tuberculous affections of the fibrous tissues of joints in the section on the articulations.

* Rokitanski, lib. cit., vol. iii, p. 117.

SECTION V.

THE PATHOLOGICAL ANATOMY OF THE VASCULAR SYSTEM IN TUBERCULOSIS.

A.—OF THE BLOOD.

Fibrinous concretions of the blood in the heart, with all the indications of having originated during life, and no evidence of previous endocarditis, are frequently found after death from tuberculosis pulmonalis. When a high degree of inflammatory action of the lungs has existed before death these fibrinous clots are never wanting; they appear to be produced by the absorption of heterologous materials and their admixture with the blood, as with the material of pus or tubercle, which, carried from the periphery to the heart, accumulate in the residuary portion of the blood in the heart and there produce coagulation; being at first small they gradually increase, and ultimately impede or prevent the circulation.

The chemical analysis of the blood in tuberculous subjects is given in the first chapter, and we have here to consider whether a post mortem examination affords any evidence of this fluid having undergone any further pathological changes in this disease; and more particularly, whether tubercle, which in the main we regard as a morbid product of the blastema exuded into the tissues from morbid blood, is ever formed in the blood itself. The preceding sections already amply illustrate the suppurative and ulcerative tendency of this disease of the blood in all its stages. The ancients believed that a great part of this fluid was converted into pus; and, although this conjecture is not verified by modern science, some observers, as Gluge, for instance, found the blood within the larger veins and in the heart, in aggravated cases, contaminated with pus-globules, to which they refer some of the effects of local disease, as hectic fever. The existence of pus-globules in the blood, if it were a general fact, would show that the pyogenic tendency takes its origin from the liquor sanguinis within the vessels; but apart from this consideration, the microscopic examination of the blood as the disease advances, and when taken from the vessels after death, convinces me that it suffers a progressive deterioration, until very frequently its crasis is completely destroyed; and the circumstance, that in protracted cases, while in the cellular structures deposition must for a long time

have ceased, absorption and destructive elimination has uninterruptedly progressed, proves that it has been rendered totally unfit to sustain the vitality and nutrition of these tissues.

There are some facts which prove that occasionally tubercle is formed in the blood itself, both within and without the vessels. Carswell found tubercle in the blood contained in the cells of the spleen; this will be described under the pathological anatomy of that organ.

Tubercle in Arterial Blood supplying diseased organs.—Mr. Rainey and Mr. Queckett have met with tubercular matter in the blood, but the most interesting and the most important point is that it was contained in the arterial blood proceeding to diseased organs.

In a rabbit in which tubercles existed in the lungs, liver, kidneys, mesentery, and other organs, some parts of the lungs, even as much as a third of a lobe, appeared very much like lungs which had never respired; others were studded with white masses of different sizes. The animal was injected, and distinct masses of white granular matter were found mixed with the injection in the *arterial trunks;* the appearance presented by the obstructed portion of the lung was due to all *the capillaries* being literally choked up by similar matter, the air-cells being free from it and containing air; the white masses in the other parts appeared to be produced by vessels filled with this matter, as in the preceding, and also by its escape into the air-cells and surrounding textures. The vessels of the kidney were filled in the same manner as in the lungs. Mr. Queckett also states, that in scrofula he has seen tubercular matter mixed with the blood pressed from an artery going to a diseased part.*

Tubercle in the Blood of the Aorta.—A tailor, 52 years old, in M. Andral's ward, died of phthisis. The lungs throughout were studded with miliary tubercles, and caverns existed in many places. The whole large intestine and lower part of the small intestine were riddled with small ulcerations about the size of a pin's head. In the centre of a clot of blood, loose in the aorta, and continuous with the clots contained in the heart, a whitish, ovoid, fibrinous mass existed, which was studded with and almost formed by a multitude of small rounded granulations the size of a pin's head, easily isolated, not suppurating nor softened, nor vas-

* Med. Chir. Transac., vol. xxviii, p. 595.

cular, but whitish, resembling miliary tubercular granulations found in the false membranes of the pleura and the substance of the lungs.*

Tubercles in Blood extravasated into the Lungs.—Dr. Watson† and M. Fournet quote a case from Andral in which tubercle appears to have been formed in extravasated blood. A man above two months ill of chronic peritonitis, who had not before presented any symptom referable to the organs of respiration, one evening suffered dyspnœa for the first time, and in the course of that night spat up a large quantity of florid and frothy blood; the hæmoptysis continued abundant five days and then diminished, and at length ceased, but the patient continued to cough and breathe with difficulty and at length died. In the right lung there were several exactly circumscribed masses of a brownish red colour, constituting "pulmonary apoplexy." One of these contained a considerable number of granulations of a yellowish-white colour, with all the characteristics of minute tubercles in an early stage. Two other of the red masses contained each a very small number of these white granules, and in the remaining masses no tubercle could be discerned, nor were there any traces of them in other parts of the lungs; but they were numerous in the false membranes of the peritoneum.

The quantity of Blood at the period of death.—Many authors remark that the quantity of blood remaining in the vessels after death in tuberculous subjects is very inconsiderable. Morgagni, however, in some instances found an immense quantity after phthisis. The elucidation of this point and the chemical and microscopical analysis of the *post mortem* blood of tuberclous subjects are great desiderata.

B.—OF THE BLOOD-VESSELS.

The Aorta.—Louis found it of a more or less bright red colour in a fourth of his cases; also invariably coarcted, which he attributed to the diminution of the mass of blood. Bizot also found it coarcted.

The Pulmonary Artery.—The late Dr. Campbell injected the pulmonary arteries of a considerable number of lungs from tuberculous subjects, both those affected with tubercle and those of tuberculous subjects who had died without tuberculization of the lungs.

* Fournet, vol. ii, p. 466.

† Lectures on the Practice of Physic, vol. ii, p. 188.

He infers, from the fact of the separation of the vermillion from the tallow of the injection, in passing through the capillaries of diseased lungs and not in those of healthy lungs, that the pulmonary capillaries are diminished in calibre in tuberculosis, sometimes generally and sometimes in part.*

The Arteries.—After death the coats of the arteries burst readily from the pressure of an injecting apparatus.† The arterial membranes are very rarely the seat of tubercle. Atheromatous deposits are not met with at all in young persons who die of phthisis, and in old ones less frequently than usual. Arterial degeneration of any sort occurs but seldom, and never to any extent in tuberculous habits; and it is the deliberate opinion of Rokitansky that aneurism and affections of the heart closely related to atheromatous disease exclude tubercle.‡

The Veins.—The coats of the veins are also almost entirely exempt from tubercle.§ Townsend found the pulmonary veins traversing the pulmonary parenchyma dilated to at least four times their natural size; those veins which are naturally no bigger than a crow quill, being as large as the fingers of a glove; the dilatation extended from the smallest branches to the main trunks, which formed two large sinuses outside the left auricle; it arose from the compression of a tubercular mass developed in the parietes of the left auricle, between the outer and inner membranes, diminishing their calibre so much at their entrance into the auricle that a probe could with difficulty be passed through. The right auricle and ventricle were dilated. ‖

There are some observations by Mr. Abernethy which of late years had been lost sight of, and I should have passed them over as of no importance, being merely incidental, but similar observations have been made recently in France, and are referred to as original by L. Parola.¶ Mr. Abernethy remarks that the Foramina Thebesii of the heart are particularly large where the lungs are extensively diseased, the effect being, to prevent disease of the heart, which would result from the plethora of the coronary vessels; the pressure on the coronary vein by the enlarged foramina assisting the return of the blood into the cavities of the heart. Mr. Abernethy also states, that when the lungs

* Lib. cit., p. 149. † Smythe on Consumption, p. 89.
‡ Hasse, p. 107. § Hasse, loc. cit. ‖ Dublin Journal, vol. i, p. 176.
¶ Della Tuberculosi.

are diseased the foramen ovale is frequently reopened; he observed this thirteen times in one year, and almost always when pulmonary consumption had long existed; sometimes the aperture was large enough to admit a finger to be passed into it; he considers this also has a tendency to prevent disease of the heart.* L. Parola, while doubting whether an open foramen ovale is more frequent in tuberculosis pulmonalis than in other fatal diseases, appears to admit that the septum is remarkably attenuated. I have several times, on close inspection, found the foramen ovale, after it had been passed over as closed, sufficiently pervious to admit the passage of an ordinary female catheter.

SECTION VI.

THE PATHOLOGICAL ANATOMY OF THE ABSORBENT SYSTEM IN TUBERCULOSIS.

A.—THE LYMPH.

The lymphatic vessels frequently contain tubercle, their tunics being apparently sound. The tubercle may be conveyed into them by absorption with the lymph, or, according to some pathologists, it may be deposited from tuberculous lymph without having been absorbed. Andral found matter, apparently tuberculous, filling the lymphatic vessels, making them appear like whitish notted cords, as well those proceeding from organs containing as from the organs free from tubercle, the structures being either in a state of irritation or free from disease. He often saw the lymphatics proceeding from intestinal ulcerations full of a matter like tubercle, and losing themselves in the mesentery, while no where else in the intestines were traces of this matter to be found.† Carswell found the lacteals proceeding from tuberculous intestinal ulcers loaded with tubercular matter, and dilated as far as the adjacent mesenteric glands, and those also passing out of the glands. The lymphatics in all parts of the body appear to absorb tubercle very readily and to convey it to the nearest group, but when the morbid material has reached one set of glands it seldom passes on to the succeeding group. Hasse remarks, that it seldom passes from the cervical to beyond the bronchial glands.‡ In a case of tuberculosis related by Mr. Cruickshanks, two-thirds of the

* Philosoph. Transact., vol. lxxxviii, 1798, p. 103.

† Path. Anat., by Townsend and West, vol. i, p. 519. ‡ Lib. cit., p. 110.

thoracic duct was filled with caseous matter.* Both Cruveilhier and Andral have observed matter of tubercular appearance in the lymphatics on the surface of the lungs.

Cruveilhier gives a figure † of subperitoneal tubercular patches from which proceed lymphatic vessels, loaded with tubercle, and passing on to the corresponding glands, where they are lost in the concrete matter into which the glands appear to be transformed; the patches of tubercle form the bases of corresponding intestinal ulcerations, and the lymphatics appear to have taken up the tubercular matter from the substance of the intestine; he traced many of them to the base, and to within the substance of the valvulæ conniventes; many of the lymphatics were obstructed at various points by extremely hard true tubercles; at the same time many of them did not arise from the neighbourhood of tubercular deposit and ulceration in the intestinal coats.

B.—THE LYMPHATIC VESSELS.

I find very few observations in the works of some of the most experienced modern pathologists on the condition of the lymphatic vessels after death from tuberculosis. Andral examined these vessels and the thoracic duct in more than 600 individuals, and in very few instances found any appreciable alteration in their parietes. In the case quoted in the last section from Cruveilhier the lymphatics were opaque and thicker than natural. In a phthisical female Andral found a partial thickening, especially in the neighbourhood of the valves, in the lymphatic vessels situate beneath the serous membrane of a portion of intestine affected with tubercular ulceration; and the late Sir A. Cooper, in the Medical Records and Researches for 1798, states, that the valves of the lymphatic vessels sometimes become thickened from deposition of a curd like tubercular matter, producing obstruction of the vessels. The disease called farcy, in the horse, in which tubercular deposits are said to occur, is regarded as an inflammation of the superficial lymphatics. The comparative immunity of the lymphatic vessels, when containing tubercle in the human subject, from any signs of inflammation, either in their own parietes or in the tract through which they pass, is a proof of the comparatively innocuous qualities of tubercle; for, notwithstanding the slight susceptibility of these vessels, they generally give unequivocal evidence of inflammation, either in their

* Lloyd on Scrofula, p. 61. † Lib. ii, pl. 1.

coats or in the surrounding tissues, when they receive, and especially when they retain, acrid or poisonous materials within them.

C.—THE LYMPHATIC GLANDS.

The lymphatic glands in any part of the body may be hypertrophied, or may become tumid and inflamed, independent of tuberculosis. In tuberculosis they may also become hypertrophied or take on inflammatory action from cold, from the absorption of irritants and other causes, constituting the simple scrofulous inflammation of the glands, slowly tending to suppuration, and when matured, secreting pus of a bad quality, and leaving ulcers possessing all the character of tuberculous ulcers, described in the first section; or these glands may be the seat of the deposit of tubercle. They present, in fact, every degree of the tuberculous degeneration of an organ, from the slightest inflammatory affection of a tuberculous or scrofulous character to complete tuberculization; hence their morbid conditions constitute a most important part of the special pathology of tuberculosis. Their great vascularity, and their particular structure opposing obstacles to the rapidity of the circulation, have been referred to as favorable to their tuberculization in early life, and the changes which take place as life advances appear to render them less susceptible of tubercular disease—they diminish in vascularity and increase in firmness.

THE EXTERNAL LYMPHATIC GLANDS.

(*a*) *Tuberculous Hypertrophy.*—Although hypertrophied glands are met with in non-tuberculous subjects, they occur much more frequently in the tuberculous, but they are only to be recognized as such by the coincidence of other local affections or other signs of the disease of the blood. This hypertrophied condition consists of three principal elements—vessels—fibrine or fibro-plastic tissue of a tuberculous quality, but not tubercle, and—glandular parenchyma and corpuscles. The aspect and consistence of the gland depends upon the predominence of one or other of these elements. They are sometimes hard, at others comparatively soft and elastic; they vary in size, from a kidney-bean to a hen's egg, or may be much larger, but in this case the tumour generally arises from several having coalesced and clustered together; a circumstance which rarely takes place without inflammation of the gland itself, or until inflammation has been excited in the surrounding tissues.

They are in general oval or ovoid, flattened, kidney-shaped, or when aggregated together they may be fasciculated. They may be superficial, loose, and moveable under the skin, or deep-seated and bound down by other structures, and in either case, when in the neck, they may form large unsightly dependent masses. They cause no pain, and may be displaced or compressed between the fingers without even exciting uneasiness. These swellings sometimes persist notwithstanding every kind of treatment.

(*b*) *Tuberculous Inflammation.*—Simple inflammation of a gland in a tuberculous subject, that is to say, "an inflamed scrofulous gland," runs the following course:—It is at first simply enlarged from thickening produced by effusion into its parenchyma, presenting a rounded surface, not as in the phlegmonous abscess, conical (Miller's Surgery); there is increased vascularity; it becomes redder than natural, and it is tender on pressure; its surrounding parts become inflamed, the skin discoloured, so as to assume the tuberculous hue, and this discoloration exists for a long time both before and after suppuration; matter forms slowly, and is ultimately discharged through one or more ulcerated openings; the discharge presents the characters of tuberculous pus, and the ulcers those of tuberculous ulcers; but the gland is not often included in the suppuration, the matter has more or less of the character of laudable pus, or more or less that of scrofulous pus, according to the degree and stage of the tuberculous affection of the blood. A tuberculous affection of a gland, of this nature, sometimes subsides without the formation of matter, and if the gland should become destroyed it is for the most part a secondary result. According to Lebert, affections of this nature are much less frequent in tuberculosis than affections of the glands with the deposit of tubercle. A gland may be simply hypertrophied in the first instance, and take on the inflammatory action subsequently.

(*c*) *Tubercle.*—When tubercle is deposited in the external glands the following circumstances may be observed. The deposit, as in other parts of the body, takes place sometimes very slowly and insidiously—sometimes more rapidly. It may occur independently of any previous inflammatory action or other obvious exciting cause, or it may apparently be induced by some such cause. In either case, after a time, the gland is found to be swollen as when simply hypertrophied, and tubercle is now more or less quickly

aggregated in its structure. The phases of its development in the external glands are thus described by Lebert. The small, soft, mobile and scarcely distinguishable gland in its healthy state, swells and becomes either unequal in consistence or hard; at this early period it may be displaced and even compressed without exciting pain; hence such glands frequently remain unperceived until they have attained a considerable volume. As the tuberculization progresses, the hardness becomes more manifest, but still it is not the hardness of scirrhous. The increase of volume at this period proceeds from the confluence of several affected glands, and this amalgamation sometimes results from chronic inflammation of the intervening tissues, and at others from compression and absorption. At this period the affection may remain stationary for years, or even for life. Some pathologists believe that the tubercle may disappear after a time by a gradual absorption. The gland, however, frequently softens, and this may occur without inflammation or suppuration; a fact observed in glands after death, and also after extirpation. Most frequently the softening is accompanied with inflammation and suppuration, and sometimes appears to be produced by inflammation. When a glandular tumour contains several tubercles, they may soften and produce several abscesses, the walls of which are indurated and contain crude tubercle. Lebert regards suppuration as almost the sole mode of elimination of tubercle from glands, owing to the rarity of absorption, and the still greater rarity of the calcareous transformation; and he considers that individuals in whom the external glands have suppurated, are less liable to internal tuberculosis than those in whom they remain crude.

A tubercular gland excites inflammation in the surrounding tisssues only when the softening has attained a certain stage. The skin becomes at first rose-coloured, then violet, thickened and projecting, and it pits superficially. The abscess becomes defined; it may open spontaneously by a small opening, which soon enlarges into a tuberculous ulcer with livid edges; or it may remain a long time without opening; the liquid portion of its contents being absorbed, and concrete grumous pus remaining. A hollow, elongated ulcer succeeds, which may be open to the external air by a fistula, through which tubercular matter escapes; or, as happens more frequently, the ulcer may be larger and the surface more exposed; yellow, friable, tubercular matter is

sometimes observed at the bottom of the ulcer, adherent to the subjacent and surrounding tissues, but this matter is detached by degrees and eliminated. As the ulcer gets rid of the tubercle, the granulations, at first pale and covered with fibrinous and purulent concretions, become cleansed; they project more, are of a brighter vermillion tint, and shew a disposition to cicatrization.

Both grey granulation and yellow tubercle are found in the external glands; when yellow caseous tubercle has been preceded by grey granulation, it remains for a long time surrounded with a semi-transparent, greyish zone. The parenchyma, at first containing isolated, tubercular points, these coalesce, and tubercular infiltration quickly occurs. The tubercular matter presents the same microscopical elements here as elsewhere; the tubercle corpuscles are distinguishable from the proper corpuscles of the gland by the latter being perfectly spherical, with a well defined outline, and a distinct nucleus frequently surrounded with a membranous envelope. The interglobular matter of the tubercle is also much more solid than that of the parenchyma. The process of softening without suppuration is described thus: the stroma liquifies, the corpuscles imbibe the liquid and swell, or burst into a granular mass without any distinct form. Suppuration first produces a mixture of pus and tubercle at the surface of the latter, and then penetrates it. When the pus and tubercle are blended they can only be distinguished by the aid of the microscope and the action of acetic acid, the envelope of the pus globule disappearing, while the tubercle corpuscles remain intact.

Lebert also states that he has observed the proper tubercle corpuscle intact in the midst of cretaceous matter, and cretaceous matter in the interior of these corpuscles. (Lib. cit., p. 118.)

The cretaceous transformation of tubercle in the external glands is a rare occurrence. Lebert met with but two instances. In a young man, aged 19 years, with tubercular glands in the neck: one suppurated, and after a time, eliminated calcareous fragments. A similar circumstance occurred in a girl, aged eight years. Lebert quotes also, from Baudelocque, a case of cretaceous transformation in an encysted tubercular gland in the axilla. The result in these cases justifies the opinion of the curative tendency of this transformation. When, during the suppuration of a tubercular gland, cretaceous particles are eliminated, the prognostic as

to the constitutional disease is favourable, it indicates a healthier tendency in the blood.

The preceding account of the pathological anatomy of these glands in tuberculosis will sufficiently indicate that it is by no means an easy affair to distinguish at all times between tuberculous hypertrophy, tuberculous chronic inflammation, and the deposit of tubercle, and that these three conditions may pass into each other, or may coexist in the same case. They occur, however, separately in innumerable cases, and it is of great importance to distinguish them in practice; attention to the history and symptoms, with a knowledge of their pathology, will in most cases ensure a correct diagnosis.

The size attained by tuberculous glands, whether hypertrophied or tubercular, is sometimes enormous: the whole neck may be completely strung round with such swellings, disfiguring the bust and face; and Dr. Cumin records, that he has seen in the case of a man of middle age, both groins occupied by vast tuberculous, glandular tumours, the larger of which equalled in size the half of a child's head at birth; they were firm, nodulated, painless, and had commenced six months previously as clusters of hard kernels, which by degrees enlarged and coalesced into these enormous masses. (Cycl. Pract. Anat., vol. iv, p. 705.)

In 614 tuberculous (scrofulous) subjects coming under the observation of M. Lebert, 175 were affected with tuberculization of the lymphatic glands or elsewhere, either complicated or not with other local tuberculous (scrofulous) affections, 439 were exempt from tubercle.

In 158 of the 175 cases of tubercle the deposit was seated in the external lymphatic glands. The following table gives a general view of the complexity and non-complexity of the disease.

1.	Tubercles in the external glands without any complications . .	67
2.	„ „ „ with various scrofulous affections .	71
3.	„ „ „ with pulmonary tubercles . .	10
4.	„ „ „ with pulmonary tubercles and other scrofulous affections	10
5.	Pulmonary tubercles and other scrofulous affections without tubercles in the external glands	17
		175

Wherever lymphatic glands exist they may become the seat of tubercle, even where in the normal condition they are in a rudi-

mentary state only. The glands of the neck are by far the most frequently affected; then those of the axillæ, the groins, and other parts of the body. Tuberculated glands rarely encroach upon the mammæ, and still more rarely occur in the popliteal space. Of the 158 cases, 84 presented ulcers, fistulæ, abscesses, and tubercular cicatrices; hence rather more than half had suppurated; but, as already stated, the tubercular deposit does not necessarily excite suppuration, although this frequently occurs after one, two, three, or six months. They are met with very frequently after the age of 15 years without deposit of tubercle in the lungs or any other internal organ, and without any symptom of general tuberculosis as an active disease; nevertheless, they occur most frequently in infancy and early youth, and they are much more liable to softening and suppuration than tuberculated glands in the interior of the body.

In the external lymphatic glands we have the best opportunity of studying the true, uncomplicated effects of tubercle on the animal economy. The morbid deposit may remain for a very long period without producing any serious inconvenience, which shews that it is not, properly speaking, a poison. It is frequently eliminated from the glands, and the affection cured without any ulterior effects on the system; shewing that the deplorable results of the deposit in the brain, lungs, and other organs, is attributable either to the particular organ in which it occurs, or to the progress of the disease of the blood. It is never fatal: when fatal results ensue tubercle is deposited simultaneously in other organs.

Carswell states, that among a great many cases examined by him, he never found these glands when generally affected, exempt from tubercular matter; and even when situated under the cutis, when this is pale, he has sometimes found them almost completely filled with the morbid product, and he arrives at a very important conclusion from these facts—that when enlarged glands in tuberculous subjects ultimately disappear, we may conclude that we have witnessed the cure of a local tubercular disease.

M. Simon has recently (Lectures on Pathology, 1850, p. 181) propounded an opinion which was entertained some time ago by Andral (Path. Anat., vol. ii, p. 453), that tubercle in the lymphatic glands is not a deposit from the blood-vessels, as in other organs, but an accumulation in the glandular tubes of the morbidly coagulable or inspissated lymph: that is to say—of tubercu-

lous lymph. He regards it as a "disease of the lymph in the glands." Andral says—"simply the result of an alteration of the lymph itself, either spontaneous or caused by a morbid condition of the lymphatic vessels, or perhaps resulting from its stagnation, owing to some mechanical obstacle to its circulation through the lymphatic plexus." The fact that Soemmering and other anatomists have frequently injected mercury into glands affected with tuberculosis in every degree, and always found the mercury traverse the lymphatics freely, is opposed to this view. M. Boeker (De Gland. Lymph., Berlin, 1826) always found it possible to inject tubercular mesenteric glands with mercury, "*their lymphatics being quite permeable.*" The observation of Cruickshank, that when the mesenteric glands are enlarged by the deposit of tubercle, if an obstruction of the ducts existed, one ought to meet with a stagnation of chyle in the first set of lacteals —a circumstance never yet observed—may be extended to other glands, and strongly supports if it does not completely establish the objection.

THE BRONCHIAL GLANDS.

We have no clear account of any other morbid condition of these glands, except such as results from the actual deposition of tubercle, although from analogy it is a reasonable inference that hypertrophy and acute and chronic inflammation occur in tuberculous subjects. They are said to be swollen, softened, and of a dull grey or black marbled hue, under inflammatory action.

(*a*) *Tubercle.*—The bronchial glands may be primarily or secondarily affected with tuberculization. The former is a very rare occurrence indeed in adults, but very frequent in children. In about 70 adults affected with tubercle in the lungs, Louis found about one half with tubercle in the bronchial glands. Papavoine found 11 of 49 children affected with tubercles in the bronchial glands without any in the lungs.

The tubercular development of the bronchial glands is described by Hasse as following a particular course. The glands at the bifurcation of the trachea are earliest attacked, and first pass through the morbid changes; thence the morbid process diverges in three directions: 1. To the glands which follow the ramifications of the bronchial tubes deep into the pulmonary texture; 2. To those situate between the pericardium and lungs, and along

the œsophagus in the posterior mediastinum; 3. To those in the anterior mediastinum, and from these to the tracheal and the cervical plexuses.

In the crude state, the tubercles deposited, according to Hasse's description, present the appearance of grey or yellow granules up to the size of millet seeds, and occupy partly the centre and partly the circumference of the gland. The gland itself is either softened or hardened, and of a colour inclining to grey. Louis remarks that the gland presents no red discoloration in the parts not occupied by the tubercle, but is generally greyish or blackish, and of increased consistence. In a short time it becomes so infiltrated as to constitute a yellowish white friable substance, in which no vestige of the pristine texture remains discernible. Hasse remarks of the glands generally, that after the loss of the original tissue, the tumours may enlarge to an enormous extent; those about the bifurcation of the trachea sometimes attaining the size of a pigeon's egg or more. If, before this increase in their size, they were but loosely attached in the midst of areolar tissue, they now, through its medium, coalesce very firmly with the neighbouring parts; acquiring, from the lardaceous increase of consistency of the tissue around, an isolating envelope.

Hasse makes the curious remark, that only where tubercle is primarily seated in the *mesenteric* glands does tuberculization of the *bronchial* glands appear to advance along those glands which follow the course of the œsophagus, passing from thence to the cervical plexus.

MM. Rilliett and Barthez examined 249 children with the following varieties of tubercles in the bronchial glands, in some of which many of the forms occurred together. They observe that it sometimes happens that gray granulations are found in the centre of the gland, while the periphery is already converted into yellow tubercle.

Tubercular dust	3	Grey or yellow masses of tubercle	201
Grey granulation	6	Softened tubercle . . .	61
Yellow granulation . , .	10	Cretaceous tubercle . . .	19
Miliary tubercles	38		

In the bronchial glands, *adhesions* to the bronchial tubes are formed through the medium of an areolar tissue, which is at first loose in its texture, but becomes daily more dense. After a time the gland cannot be detached from the bronchus, when a series of changes occurs, resulting in the softening of the tubercular

matter and the communication of the interior of the cyst with the bronchial tube, probably sometimes by erosion and ulceration, but most commonly by interstitial absorption from pressure. Perforation occurs occasionally while the tubercle in the diseased gland is in a state of crudity.

Softening.—As in the lungs and other parts, the mass within the glands may continue in a crude state a longer or shorter time, but for the most part a low form of inflammation attends the progress of the swelling, and the gland undergoes the softening process, becoming part of a large abscess, and being in the end entirely destroyed. When the softening proceeds from the centre, one or more little excavations are first formed, containing a gritty purulent fluid, in which case the process is slow. When the softening commences at the circumference, the filamentous sheath of the gland becomes highly vascular and puffy, ultimately constituting a mere cyst around a thick, yellowish, tuberculo-purulent fluid. In either case an abscess is slowly formed, with some degree of redness, pain and heat. The tumour has now, except under the circumstances above mentioned, attained its utmost magnitude, and from this moment collapses, its contents, identically the same as the tubercular deposit in any other organ, escaping through an opening of its own making, which constitutes a tuberculous ulcer with all the characteristics already described, or in rarer cases it may be gradually absorbed.

Absorption.—This proceeds very slowly, being carried on, in part, by the red velvety vascular coat, and in part, probably, by imbibition, forming a bronchial vomica, which, as will be described of vomicæ in the lungs, for the most part possesses an unorganized membranous lining containing thickened pus and tubercle; but the cavity does not, as the pulmonary excavation, continue to enlarge; its walls receive no additional deposition of tubercle, and rather seem to act as a shield. In Hasse's experience no instance ever occurred of the reduction of two adjacent glands into one common excavation. On the contrary, in proportion as its fluid contents are absorbed, the cyst closes in upon the more consistent, pap-like residue, which, lessening by degrees, acquires a mealy and cretaceous character, and eventually assumes a stony hardness. Such products are frequently met with, even in youth, in the place of bronchial glands, more especially at the bifurcation of the trachea, the morbid process observing the same order of development as

the original development of tubercle. MM. Rilliett and Barthez met with but one instance where the contents of the cyst were completely absorbed: in a child aged six years, the glands being entirely tubercular, two of these had penetrated the lung, of which one was small and crude, the other large and quite softened, surrounded by a cyst with fine walls, this being lined with a false membrane, the interior of the cyst being almost empty, without any communication with the bronchia.

Compression of the neighbouring parts.—Tubercular bronchial glands produce more or less compression:—1. *Of the vessels.* The vena cava superior, the pulmonary artery and veins, the vena azygos, for instance. Obliteration of the vessels is rarely produced, but the circulation of the blood is frequently interrupted. M. Tonnelé saw the vena cava superior compressed by a tubercle between it and the vertebra, pressing the vein out of its site, making it describe a kind of revolution around itself, so as to bring its walls into contact, and interrupt the course of the blood. Constant records a case of compression of the pulmonary artery. Compression of the vessels may produce hæmorrhage, or œdema, in distant parts, as in the arachnoid or lungs. 2. *Of the trachea and bronchiæ.* This is a more frequent occurrence; the trachea has been found contracted, where it is surrounded by glands, resuming its normal diameter a little above the bifurcation; or compressed laterally. The large bronchiæ of both lungs have been found contracted. MM. Cloquet, Leblond and Barthe, saw examples in which these tubes were obliterated. MM. Rilliett and Barthez never met with an instance. The bronchial tubes within the lungs, are seldom compressed, being kept on the stretch by their cartilaginous rings, and the substance of the lung being yielding. 3. *Of the nerves.* The pneumogastric nerves and their ramifications are frequently compressed. Generally, the structure of the nerve is not altered, but in one instance MM. Rilliett and Barthez found a nerve displaced by a gland to which it adhered, being thickened at the point of adhesion, and its ramifications in the diseased glandular mass obliterated. Wrisberg found the pharyngeal nerve compressed. Merriman saw the left recurrent nerve compressed at the point where it crosses the aorta; it was displaced nearly half an inch from its ordinary site, and its tissue manifestly altered. 4. *Of the œsophagus.* We have no records of the compression of this tube. M. Berton records two cases of simple displacement.

The reason that perforation takes place more frequently into the bronchial tubes than into the vessels or œsophagus, appears to be that the bronchiæ cannot recede from the compression; there are adhesions readily established between them and the neighbouring glands, and these adhesions gradually become more intimate; softening of the tubercle then occurs, and a communication becomes established.

Perforation of the neighbouring structures.—This is a frequent result of softening of tubercular bronchial glands; it takes place most frequently into the *bronchi,* and according to Hasse it occurs most frequently from without inwards, commencing in ulceration of the bronchial mucous membrane, which, progressing into the tubercular gland, the contents of this burst through the bronchus, determining an irregular passage and opening through which they escape. Sometimes the contents of bronchial glands escape into the parenchyma of the lungs, giving rise to cavities which closely resemble those resulting from pulmonary tubercle, distinguishable from them—by invariably occurring near the spot where the great vessels and bronchi enter the lungs—by their direct communication with glands—by being for the most part limited in size, and smooth on the inside—and by the circumstance that the bronchial tubes do not enter straight, that is with the whole ring of their corroded extremity, but only through a lateral and often a very narrow orifice.

The perforations within the bronchi vary in character. If they communicate with a cyst in which the matter is in a crude state, the perforations are short, nearly circular, and present little or no traces of injection—if within a cyst containing softened matter, the wall of the bronchus in contact with the cyst is bright red, worn from without inwards, irregular at its edges, and generally presents remains of the cartilaginous rings.

Perforation into the *pleura* is still more rare—Hasse says only possible where the gland is situated immediately under the pleura, at the inter lobular divisions. Berton, and Rilliett and Barthez, witnessed the extraordinary coincidence of the same gland having perforated the pleura and a bronchial tube, so as to induce pneumothorax.

Perforation of the *œsophagus* is less rare. Berton and Leblond each saw an example in children. Here the pus is evacuated by degrees, in occasional gushes, on retching or coughing, sometimes

a very large quantity being discharged at one time. The empty gland may collapse, firmly coalescing with the œsophagus, and thus contributing to establish a deep cicatrix. Hasse met with five examples of this nature in aged persons, the base having in every instance been formed out of the hard blackish remains of a gland. Simultaneous perforation of the œsophagus and trachea has been seen in the adult. Syme records the case of a man aged 45, in whom a tubercular bronchial gland communicated with the trachea, the œsophagus, and the pericardium.*

Three examples are known, all in children, of actual perforation of the *pulmonary artery*—a main bronchial trunk and a large branch of the pulmonary artery were simultaneously penetrated by a bronchial gland, death taking place instantaneously under profuse hæmorrhage. Lebert met with a case in which an abscess of a bronchial gland had opened into the *pericardium.* (Lib. cit. p. 667.)

Rilliett and Barthez have observed perforation in which the base was formed by the tubercle of a gland in a state of crudity, and they believe that perforation is not invariably owing to softening or ulceration, but depends simply upon compression and intermittent absorption. In such a case the edges of the perforation are round and well defined, and there is no appearance of vascular injection.

Extravasation of Blood.—This is an occasional occurrence from other than the above causes. Rilliett and Barthez met with two cases. In one of these, a boy aged 11 years, died after a frightful hæmorrhage produced by a blow on the back by one of his companions. The bronchial glands were the size of a large apple, and were entirely converted into a grey tissue, interspersed with a small quantity of yellow tubercle. They were the largest bronchial glands they ever saw. No trace of vascular perforation was met with, there being merely pulmonary ecchymosis. They explain the occurrence of the hæmorrhage by the compression of the large vessels preventing the return of the blood, which had been unduly forced into the lungs by the increased action of the heart, under a shock or moral emotion. (Lib. cit., p. 185.)

The Curative Process in Tubercular Bronchial Glands.—Hasse thus describes the curative process.—Years may be occupied in

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* Edinb. Med. and Surg. Journal, vol. xliv, p. 113.

complete recovery. The aperture into the bronchia gradually heals to a point, whilst the subjacent gland shrivels, or else closes before its contents are entirely voided; the remainder subsequently becoming calcareous. Occasionally a renewed irritation at a late period restores the communication, and calcareous concretions pass away. The deep, blackish scars formed are met with in the mucous membrane of the bronchiæ, and their real origin is revealed by making a vertical section, by which the subjacent shrivelled gland is simultaneously divided. When this process affects glands deeply situated within the lungs, where the bronchi are no longer cartilaginous, the perforated canal contracts after healing, which is the more conspicuous as the glands within the lungs are always seated at the acute angle of the bronchial divisions, and for the same reason two canals are often perforated at once. Sometimes the repair is effected differently; the opening gradually enlarges, until an extensive excavation occupies one side of the tube, the continuity being ultimately restored by cohesion of the glandular walls, and the loss of substance replaced by the cavity filling with a fibro-cartilaginous mass. The latter appears, however, to be a very slow process, as openings of this kind are frequently met with in many old persons. The sustained irritation about these ulcerated patches causes the bronchial cartilages to ossify, and afterwards to project, as naked splinters, beyond the brink of the cavity.

The following is Dr. Carswell's description of the curative process: — "In individuals who had recovered from scrofula and pulmonary phthisis, but who died some time after of other diseases, I have found these glands situated at the bifurcation of the trachea, where they are generally most frequently and most extensively affected, as well as some way up the trachea, containing a greater or less quantity of a substance resembling putty or dry mortar, the consistence of which was sometimes equal to that of sand-stone or bone. This substance has generally a stellated form, or presents a number of sharp spiculæ projecting from a central mass, which excite inflammation, ulceration,—and hence perforation of the walls of the trachea or bronchial tubes, with which they come in contact. A direct communication is thus formed between the cavity of the air-tubes and the diseased glands, through which the cretaceous bodies pass; and they are rejected along with the expectorated fluids. I have seen several

examples of cure of tubercular disease of the bronchial glands, effected in the manner just described. The patients were generally advanced in years, and had frequently observed the cretaceous matter in their sputa, portions of which have been shewn to me, and were found to present all the physical characters of that which was afterwards detected in the bronchial glands. When these glands have evacuated the whole of their contents, they are found atrophied, and converted into a fibrous tissue, which fills up the external orifice of the perforated air-tube. The accidental opening now contracts, becomes obliterated, and leaves in its place a puckered depression or cicatrix, seen on the internal surface of the air-tube."

Carswell represents a bronchial gland situated at the bifurcation of the trachea filled with a number of irregular spiculated cretaceous bodies, one of which is making its way through a perforation in the left division of the trachea immediately over the diseased gland. The cicatrix of a similar perforation of the trachea is also represented, the remains of the gland having been found adhering to the external surface of the trachea in the situation of the cicatrix.—(Pl. iv, fig. 4.)

In advanced, and even in old age, the bronchial glands are by no means infrequently found to have undergone the changes here described, but these changes are generally of long anterior date, virtually the remains of cured bronchial tuberculosis.

MM. Rilliett and Barthez describe the case of crude glandular and pulmonary tubercles combining. They state, that in young subjects they sometimes approach each other and unite. In such subjects tubercles have a great tendency to aggregate under the pleura on the surface of the lung, and to increase inwards through the parenchyma. At the same time that the sub-pleural tubercle advances towards the central parts, a tubercular gland, seated at the root of the lung, advances in the same direction, until the two masses unite from opposite points, and by cutting into them transversely the existence of a long tubercular cylinder traversing the lung from one surface to the other is demonstrated. Tubercles seated in the centre of the lungs may in the same manner be combined with bronchial tubercles; the intermediate pulmonary tissue being destroyed by pressure and interstitial absorption. When these crude tubercles soften, if the softening occurs first in the bronchial gland, they may open into the lung, and a cavern is

thereby produced; or, if the softening commences in the lung, the cavern ultimately involves the glandular mass.

b. Melanotic Deposit in the Bronchial Glands.—A great peculiarity in the tuberculization of the bronchial as compared with the other lymphatic glands consists in the deposition of black pigment. Hasse says, whenever the tubercular mass has remained until long after puberty, or the disease has arisen at a later period, this peculiar substance is met with both in the unsoftened and in the pap-like mass. With the latter it becomes so intimately combined as ultimately to constitute an uniform, black, smeary pulp. Sometimes the mass contracting its contents remain soft for years. Sometimes calcareous masses or separate calcareous nuclei are found in the midst of the blackened mass.

THE MESENTERIC GLANDS.

Morbid changes of the mesenteric glands, although less frequent than those of the bronchial glands, are among the most common consequences of tuberculosis; they were noticed at a very early period, and referred to the true cause. These glands are subject to all the affections already described, but their tuberculization has elicited the most attention from morbid anatomists. Inflammation, as a consequence of the deposit of tubercle, is minutely described, but there can be no doubt that congestion and inflammation may occur in tuberculous subjects, even though the blood is not matured for the production of tubercle. There are several circumstances which give a remarkable speciality to this particular localization of tuberculosis.

(*a*) *Hypertrophy.*—The mesenteric glands are at first tumefied from sanguineous congestion, and then hypertrophied either with redness and hyperæmia or fulness of their tissue, in tuberculosis as in all other diseases, when the intestinal canal becomes the seat of irritation. It is an important remark of Andral's that the hypertrophy occurs subsequently, whether the irritation continues or ceases, and it is liable to be permanent.—(Path. Anat., vol. ii, p. 87.)

(*b*) *Tubercle.*—Baillie describes tubercular mesenteric glands. He found the gland in part changed into a white, soft, curdy matter, not uncommonly mixed with pus. Louis found them tubercular in 23 out of 102 adult phthisical subjects; MM. Rilliett and Barthez in one-half of the tuberculous infants they examined;

but they were extensively diseased in not more than one-seventh of the whole number affected, and in a sixteenth only of the children who died with tubercle in some point of the economy.

We learn from Mechel and Andral that a mesenteric gland undergoing tuberculization sometimes becomes, in the first instance, redder and firmer than natural, it then enlarges, and becomes elongated; at other times the gland is pale, its consistence uniform, and its shape natural; when tubercle commences forming, the tubercular matter first occupies the centre of the gland, developing itself at one or many points; it may continue to be isolated, or become infiltrated and increase the whole gland. The tubercle passes through all the phases of its development, being first crude and white, or opaline or yellowish. At first it appears to be traversed with vessels, but subsequently they disappear; ultimately, softening occurs in all its stages from a pap-like fluid to tuberculous pus, but this is rarely very fluid, it mostly consists of curdy clots suspended in a rather thick purulent matter.

The circumstances relating to the deposit of tubercle in the mesentery do not essentially differ from those already described. A few of the glands may be affected, or more frequently a great number, or even the whole. They are of very variable size, and sometimes run into masses placed along the vertebral column, and sufficiently large to distend the mesentery, and render it immobile, when they may compress the aorta or the ascending cava; or they are heaped together like a quantity of peeled chesnuts, to which they have some resemblance. At other times, the tumour may be moveable from one side of the vertebral column to the other. The tumours are of all sizes, from that of a pea to that of the head of an infant (Portal). The glandular tissue may become completely filled, or the deposit may occur partially, towards the centre or the circumference, the unoccupied portions being in a state of congestion, as represented by Carswell (Pl. iii, fig. 1). Most frequently the glandular tissue disappears entirely, and is wholly replaced by tubercle. MM. Rilliett and Barthez found in children the unoccupied portion very rarely inflamed, and they state that these glands give unequivocal evidence of the deposit of tubercle without any previous inflammation.

In the adult, Louis found the glands near the cœcum most frequently affected. In all the cases except one, even where the deposit was in the miliary form, it consisted of yellow tubercle;

the exception consisted of a small quantity of semi-transparent grey matter in the midst of a partially tuberculized gland. They had very rarely undergone softening, which Louis attributes to their recent development. They were generally enlarged, and when a few spots only occurred, the glandular tissue sometimes appeared of a more or less bright red colour, and a little softened, from which it is inferred that inflammation had some influence in a certain number of cases, but in others the gland had not undergone any change in colour or consistence.

In every case, ulcerations of the intestines which had not formed without primary or consecutive inflammation, were met with, and the tubercular glands were directly associated with the portions of intestine affection. The degree of tuberculosis of the gland, however, did not bear a proportion to the degree of ulceration, and in a case in which all the mesenteric glands were completely transformed into tubercle, the mucous membrane was perfectly healthy, with the exception of a rounded ulceration, of one line in diameter, with pale and flat edges, in the neighbourhood of the cœcum. Louis concludes that if inflammation of the glands, and inflammation and ulceration of the corresponding portion of the mucous membrane, should be regarded as the exciting cause of mesenteric tubercles in certain cases, there are others in which these products acknowledge no such causation.

When the glands were not tubercular, Louis observed them, in cases of phthisis, pretty frequently of considerable size, and of a more or less bright red colour.

Pathological investigations, subsequent to those of Louis, have left no doubt of the existence of primary tuberculosis of the mesenteric glands, occasionally in the adult and much more frequently in children. This constitutes the anatomical element of the variety of the disease which comes under the designation of *Tuberculosis mesenterica* (*Tabes mesenterica*). Andral, as quoted by Louis, gives a case in which the lungs were perfectly healthy.

A young man, æt. 17, died from extensive tubercular disease of the mesenteric glands, the lungs presenting no trace of tubercle. (Revue Medical, Sep. 1842.)

MM. Rilliett and Barthez met with cases in children in which the mesentery was the only part affected.

Adhesions and compression of the neighbouring parts.—Adhesions of the mesenteric glands through the medium of the peritoneal

coat to the corresponding peritoneal coat of the adjoining parts, are by no means infrequent, as between the mesentery and intestine or two portions of mesentery. When these adhesions form a ring capable of receiving a noose of intestine, strangulation may occur.

Other evidences of peritoneal inflammation, when they occur, are generally slight, and limited to slightly increased vascularity, or a little inequality of surface.

The effects of tubercular disease of the glands of the mesentery on the neighbouring parts, as compared with those of the thorax, are very different. Owing to the parietes of the chest being osseous and comparatively inextensible with the comparative solidity of its contents, and those of the abdomen being soft and extensible, the glands in the latter may acquire a much larger volume, they exercise less compression on the surrounding organs, and the parts are less subject to adhesions and perforations. The abdominal vessels are much less liable to compression, when the mesentery is the seat of tubercle, than when the deposit occurs in the peritoneum, and serous effusion is a rare result. As above shewn, we see the abdomen sometimes filled with tubercle with as little derangement of the general health as in tuberculosis of the external glands. On the other hand, compression may sometimes occur. MM. Rilliett and Barthez give a case in which adhesion to the intestine and perforation took place. Cowper, as quoted by Morgagni, speaks of a child greatly emaciated, in whom the receptaculum chyli was compressed by two enlarged mesenteric glands.* Portal met with cases of erosion of the peritoneum, the pus from the laminæ of the mesentery being effused into the abdominal cavity.

In Children.—Rilliett and Barthez examined 144 cases of mesenteric tubercles, consisting as follows:—

Of yellow granulations	7
„ miliary tubercles	57
„ tubercular masses	84
„ softened tubercle	13
„ cretaceous tubercle	8

As respects the extent of tuberculization, the result was—

A very few tubercles in	75
Rather numerous	48
Numerous	20

* Cyclop. Pract. Med., vol. iv, p. 149.

Softened tubercle was found most frequently between the age of three and sixteen years. They never found grey granulation in the mesentery. When the affection was extensive, it most frequently coincided with a similar affection of other organs, but cases are occasionally met with in which the tubercle is exclusively concentrated in the mesentery, and the coincidence of mesenteric phthisis and peritoneal phthisis is a rare occurrence. Notwithstanding the remark already quoted from Louis, that in the adult the glands opposite the cœcum are most frequently the seat of tubercle, statistics are not at present on a sufficient scale to enable us to determine whether the disease is more prone to attack one part of the mesentery than another, or to determine the circumstances under which this might happen.

The curative tendency.—On comparing the pathological anatomy of the mesenteric and the external lymphatic glands in this disease, it will be found that either may become tubercular and remain so for years, without producing any general secondary effects in the system. This was noticed by some of the older writers.

Ambrose Parey quotes a case from Ingrassius, of a certain Moor, hanged for theft, in whose body, publicly dissected, were found 70 scrofulous tumours of the mesentery, and many abscesses contained in cysts adhering to the peritoneal coat of the intestines, particularly of the large intestines, the liver, spleen and lungs being healthy; this man was in apparently perfect health till the period of his execution.

Morgagni gives the case of a negro girl who died suddenly, apparently in good health; the mesenteric glands were enlarged and scrofulous. Bayle reports the case of an infant who died from a burn while in perfect health, fat, and in good condition; there were tubercles in the mesentery, and in some of them suppuration had commenced.

It is astonishing also to what an extent tubercular disease of the mesentery will proceed, with only trivial symptoms and before producing fatal consequences.

Portal quotes from Tulpius the case of a child, aged two years, in whom a mesenteric tumour weighed 18 lbs., and remarks that it is not only the glands or the lymphatic vessels of the mesentery which are obstructed in such a case, but the morbid element is deposited in the folds of the mesentery, he states also that he has seen the mesentery, mesocolon and mesorectum completely filled.

The above observations prepare us to understand that mesenteric phthisis is a more curable disease than pulmonary phthisis.

Dr. Carswell gives a most instructive case in illustration. The patient was affected with the disease when a child, and also had swelled cervical glands, some of which ulcerated; she died of inflammation of the womb seven days after delivery, at the age of 21 years; several of the mesenteric glands contained a dry, cheesy matter, mixed with a chalky-looking substance; others were composed of a firm cretaceous substance, and a tumour as large as a hen's egg included within the folds of the peritoneum, which appeared to be the remains of a large aggregated mass of glands, was formed into a substance resembling a mixture of putty and dried mortar, moistened with a small quantity of serosity; in the neck also, and immediately beneath an old cicatrix, there were two glands which contained in several parts of their otherwise healthy substance, small masses of hard cretaceous matter.

D.—THE THYROID BODY.

Hasse (Lib. cit., p. 388) affirms that the avowed relation between bronchocele and tuberculosis is groundless. He never met with tubercles in this organ, and Sauter * has observed that persons affected with extensive bronchocele seldom or ever become subjects of phthisis.

SECTION VII.

THE PATHOLOGICAL ANATOMY OF THE VISCERA IN TUBERCULOSIS.

I include in this section the cerebral, the thoracic and the chylopoietic viscera.

A.—OF THE NERVOUS CENTRES AND NERVES.

In tuberculosis, when the brain and the other nervous centres have remained to the last perfectly free from local disease, they are paler and softer than natural, as in most other chronic affections. Dr. Boyd found the encephalon, in a considerable number of cases of tuberculosis pulmonalis, both in males and females, somewhat heavier than the natural standard.† It is frequently extremely difficult and sometimes impossible to determine whether the various

* Œster. Jahrb, N. F., vol. xx, fasc. i.

† Edin. Med. and Surg. Journ., vol. lxi, p. 288.

pathological conditions of the nervous centres about to be described have been primarily developed in the substance of the organs or in the membranes, but it is now generally admitted that either circumstance may occur.

The Pathological Results of Tuberculous Inflammation.—Whether occurring primarily or propagated from the membranes, the nervous centres frequently exhibit the results of inflammatory action. The white substance may be more or less abundantly dotted with red points, and sometimes a general rose colour prevails; the grey substance may be of a rose colour; there may be *red softening;* but, according to Rilliett and Barthez, seldom proceeding in children, to diffluence; and rarely extending very far from the surface. These effects may be accompanied with those of tubercular meningitis and with ventricular effusion. The effused liquid is opaque, containing albumen or purulent flakes. Its opacity, however, may depend either upon its being secreted under acute inflammatory action of the membranes, or upon its containing a portion of broken-down cerebral matter; the liquid, by extension and transudation alone, breaking up the softened commissures or the septum-lucidum. The turbid liquid occurs in comparatively small quantity and is formed rapidly. These pathological appearances correspond with inflammatory action, for the most part acute, and constitute one of the most frequent anatomical elements of acute hydrocephalus.

On the other hand, the effused liquid may be perfectly limpid and transparent, without any yellow or green tint, and containing little or no albumen. It may, however, contain broken-down cerebral matter, and may be accompanied with *white softening,* traversing the membranes and softening the cerebral mass, so as to break it up and cause it to run like viscid cream. This is not an inflammatory softening of the nervous substance, but a simple imbibition. When effusion into the ventricles is of this character it is mostly formed slowly, occurs in very large quantities, is sometimes accompanied with opacity, thickening, induration and tuberculization of the membranes, and corresponds with cerebral tubercles only, constituting the anatomical element of chronic hydrocephalus.

Thus the brain may be the seat of tuberculous inflammation of various grades, it may also be the seat of tuberculous or scrofulous abscesses, of red and white softening, and of the deposit of tubercle.

Yellow softening.—That peculiar yellow softening, so well des-

cribed by Rokitanski (Path. Anat. Syden. Ed., vol. iii, p. 419), the real nature of which is so doubtful, is also met with in tuberculous subjects. It occurs for the most part, if not in all cases, secondarily to the deposit of tubercle.

Tubercle.—The deposit of tubercles in the brain, like tubercles in the membranes, occurs much more frequently in childhood and youth than at later periods of life, and almost always before puberty. Cruveilhier never saw them in old people. The crude yellow miliary tubercle is the usual variety. In 37 children with tubercle in the brain Rilliett and Barthez found:—

Crude yellow miliary tubercles	in 27
Masses of tubercle	„ 6
Softened	„ 11
Cretaceous	„ 2
Grey infiltration	„ 2

On opening the cranium where tubercles exist in the brain the encephalic mass sometimes appears as if hypertrophied, or it appears tumefied in a particular part, more or less circumscribed. The convolutions are then flattened, and in cutting into them a tubercular mass is found. Sometimes the cortical substance covering a large tubercle is atrophied and even perforated; the membranes are very rarely ruptured, or the osseous tissue invaded.

The *number* of tubercles in the brain is usually very small, one or two being met with in most cases, and more rarely three, four, five, or a few more. In this, cerebral contrasts with pulmonary tuberculization. In some rare cases, in children, fifteen, twenty or more are found. Cruveilhier quotes a case from Reil in which there were more than 200 occupying both brain and cerebellum; also the case of a child in which there were 50 in the brain and cerebellum, some miliary, others as large as a nut, generally occupying the surface; one was in the substance of each optic thalamus, a large one occupied the middle lobe of the cerebellum, and projected into the fourth ventricle; another, connected with the pia mater, was lodged in the fissure of Sylvius. In the brain, tubercles are for the most part found widely apart from each other, and not aggregated together, unless large, when they are sometimes formed of numerous aggregated tubercles.

Their *size* in the brain is generally considerable, being larger in proportion as the number is small; varying from the size of a millet-seed to that of a hen's egg or larger, the most usual size

being that of a hazel-nut or walnut. When the number is small each separate tubercle acquires a considerable magnitude.

The *form*, owing to the yielding qualities of the surrounding substance, exhibits no peculiarity; they are most frequently round, but they may be irregular, branched or lobular, and their surface is sometimes smooth, and sometimes as it were mammillated. M. Léveillé* and Dr. Copland † have insisted much on two predominant forms, one consisting of flattened, irregular patches of variable thickness, the other, globular, ovoid, and somewhat flattened; but every variety of form is occasionally met with, and it does not appear that this distinction has any particular signification.

Their *seat* is by no means confined to any particular part of the brain. Rokitanski found them common in the cerebrum, and less so in the cerebellum. Cruveilhier found them more frequently in the cerebellum. They occur most frequently in the hemispheres, rarely occupy the white substance primarily, and are seldom found in the pons, still more rarely in the medulla oblongata. They most frequently occur in the grey substance, either near the periphery, or more deeply-seated in the grey portions of the corpora striata and optic thalami. They sometimes appear as if interposed between the cineritious and medullary matter. The corpus callosum, fornix, septum lucidum, and crura, scarcely ever contain any; tubercles are, however, sometimes completely encased in the medullary substance. The adhesion of tubercles projecting into the substance of the brain requires to be carefully distinguished from infiltration into the cerebral matter itself; in the latter case the tubercular matter frequently forms an imperfectly softened mass permeated by blood vessels.

Andral points out that the parts of the nervous centres most liable to hyperæmia and inflammatory softening are not those which are most liable to the deposit of tubercle.

When situated near the surface tubercles of the brain frequently break through the superficial layer of cerebral substance and fix themselves in the tissue of the pia mater, giving rise to exudations into this membrane and the arachnoid, and sometimes becoming adherent not only to these membranes but to the inner surface of the dura mater—they are then liable to be mistaken for tubercles of the membranes, which we have already seen, sometimes depress

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* Dissert. Inaug., No. 2, 1826. † Dict. Pract. Med., vol. i, p. 122.

the substance of the brain, and form for themselves a sort of cavity in which they rest.

The *density* of cerebral tubercles is sometimes considerable, being frequently of the consistence of lard or cheese, and firm, but easily lacerable. This consistence depends upon the period of their development, so that a period of crudity and another of softening is generally admitted. They are sometimes softened at the centre, and contain numerous cavities of various sizes, in many instances filled with pus, having all the qualities of phlegmonous pus.

Their *colour* is greenish-yellow or yellow, but in some parts they often appear paler than elsewhere, being of a dull reddish-white or white colour, corresponding with an increase of density. The paler varieties are generally regarded as most recent; sometimes they are of a citron-yellow at the periphery, and of a deep orange in the centre. The tendency to become green is peculiar to cerebral tubercles. They occasionally consist of whitish granulations, and occasionally, being hard, they are resplendent, and, as it were, pearly.

Although the cerebral substance in the neighbourhood of tubercles is often perfectly healthy, they are generally surrounded by a considerable layer of pale-reddish vascular substance, which often becomes paler in some parts than in others, and dense and resistent like a cicatrix, establishing the fact of conversion into a fibroid callus, outside the tubercle; while there is a layer of extremely delicate, moist, jelly-like cellular structure connecting the whole with the surrounding cerebral tissue, the texture of which is so slight that the whole morbid mass may be easily enucleated. This stratum frequently contains, scattered through its inner part, some small grey or greyish-yellow tubercles which occasionally unite with the great cerebral mass; it is scarcely ever absent, and is the product of a moderate inflammatory process tending to induration, as in other tissues. From this membrane the surface of tubercles sometimes appears to be permeated with vessels and sometimes not; sometimes the tubercles may be lifted out of their bed without rupturing any vessel, sometimes not—and from this condition of the surrounding parts, the statement of morbid anatomists that they are sometimes encysted and sometimes not will be readily understood. The tubercle is, moreover, sometimes found in consecutive layers, some

of which are transparent, and, when seated deeply in the brain, often fissured and spread out in various directions.

The statement of Rokitanski that some rare cases prove that tubercle in the brain does, in part at least, commence in the form of grey translucent granulations, portions of a tubercular mass being found in that state, is most important. From all the observations of morbid anatomists it appears, however, it can continue but for a short time in that form, but very quickly passes into the stage of yellow cheesy tubercle.

After tubercles are entirely *softened* in the brain their place is found occupied by a cavern, mostly of a spherical form, which is enclosed in the peripheral vascular stratum already described, having the character of an encysted abscess; the interior of the stratum being in a state of suppuration, and secondary deposits of tubercle, which may also soften, being found in it. The character of tubercular matter may disappear, and then the tubercular nature of the abscess is only to be distinguished by the concurrence of tubercle in other parts, and the general signs of the tuberculous constitution. Some of the scrofulous abscesses of the brain described by the older writers, were probably of this nature.

Cretification occurs in some very rare cases, not only in one but even in several extensive tubercles. The chalky masses are generally enclosed in cysts of variable thickness.

Tubercles in the substance of the brain very frequently coincide with tubercles in the membranes. In 51 cases of children the following proportions were observed:—

Meningeal and cerebral tubercles combined	19
„ tubercles alone	33
Cerebral tubercles alone	18
Meningeal and cerebral tubercles combined, with predominance of the meningeal	7
Meningeal, with predominance of the cerebral	4
„ and cerebral, in quantity nearly equal	8

In some very rare cases tubercle in the brain is the only localization of tuberculosis, but, as a general rule, it coincides with the local development of tubercle in other organs. Its most frequent concomitants are tubercles in the absorbent glands; the next in frequency, tubercles in the lungs; and after this, in the mesentery. M. Leguillon records two cases opposed to the law laid down by Louis, in which tubercles in the cerebrum and cerebellum existed

without any affection of the lungs.—(Journ. Hebdomad., t. ii, p. 33. 1835.)

Rilliett and Barthez recognized in children, chronic inflammation of the pia mater, with thickening and induration, and its transformation into grey matter followed by yellow tubercular infiltration; also tubercle deposited, originally producing inflammation of the pia mater and its passage into a state of grey tissue; but grey matter may occur in the brain independently of the pia mater—thus, they observed a crude yellow tubercle, the size of a nut, encased in the brain and nearly surrounded with a layer of very clear resistant semi-transparent grey matter, having the closest analogy to the semi-transparent grey matter of the membranes, and establishing the identity of the grey and yellow matter.—(Lib. cit., p. 480.)

As in the membranes, tubercles in the brain may occur without manifesting themselves by the usual symptoms; the same anatomical lesions characterize this comparatively latent form—grey or yellow granulations and miliary tubercles; the results of chronic and even of acute inflammation of the membranes;—as effusion, the deposit of greenish lymph, concrete pus, thickening, opacity, ventricular effusion—turbid or limpid—softening of their parietes, &c.; lastly, tubercles in the substance of the brain, as numerous and even as large as when symptoms prevail. These lesions occupy the same sites and assume the same forms as in ordinary cases. The only difference which Rilliett and Barthez observed, was that already stated—the lesions without symptoms coincide with very advanced general tuberculosis; whereas, when symptoms present themselves, the cerebral affection coincides with tuberculosis little advanced as respects the state of other organs. This, however, is only a difference in proportion, since this latent form has sometimes been observed with a small number of tubercles in other parts of the body.

Tubercles in the brain, even of large dimensions, have been discovered after death produced by causes other than tuberculosis of the encephalon, their existence not having been suspected during life. Cruveilhier believes that the resorption of tubercle in the brain is not impossible.

Œdema of the Brain.—General œdema of the brain is met with occasionally in tuberculosis. The organ may be in a soft, pasty condition, or even broken down into a diffluent watery pulp, already described as white softening; it occurs in the neighbour-

hood of the ventricles containing fluid, and around tubercles and inflamed portions of the organs. The remaining portions of the brain are sometimes œdematous in a slight degree, showing that the softening does not necessarily depend upon inflammation, particularly in tuberculosis pulmonalis, but is rather associated with the watery state of the blood. In cases of acute hydrocephalus this general œdema sometimes comes on rapidly, at other times it is developed slowly. A considerable enlargement of the brain is a frequent consequence.

Important instances of the local development of tuberculosis in the nervous centres will be found in most works on pathology. Carswell represents in one case masses of yellow tubercle, both in the medullary and the cortical portion of the hemispheres, having a uniform aspect, and of the consistence of new cheese, the cerebral substance around the tubercular matter being perfectly healthy.—(Pl. iii, fig. 2).

A single tubercle occurring in the cortical substance is exemplified in a case recorded by M. Godolier. In a man who died of phthisis upon which motor paralysis supervened, a large round tubercle more than three centimetres in diameter was found lodged in the centre of the left lobe of the *annular protuberance;* its surface was greenish, and its centre indicated the commencement of softening; the surrounding cerebral substance presented no alteration in colour or consistence; the consistence of the tubercle was that of hardened yolk of egg, it was slightly puckered on its external surface, between which and the cerebral substance a few small vessels glided, but there was no pseudo-membrane or cyst of any kind. (Gazette médicale de Strasbourg, No. 10, 1850.)

Extensive tuberculosis involving the brain is also illustrated in the Archives Générales, Sep. 1851 (from Casper's Vochensch, 1850). A scrofulous child aged two years died after an illness of twenty-six days with cerebral symptoms. The vessels of the pia mater were dilated and gorged with blood; there were numerous large yellowish tubercles on the surface and on the convolutions of the right hemisphere; the brain was large and œdematous, and the lateral ventricles filled with serum; above the orbit there was a tubercular deposit the size of a walnut, and ten other tubercles the size of hazel nuts in the interior of the same hemisphere; at the base of the anterior lobe of the right hemisphere a tubercle equally large; at the base of the left middle lobe a deposit of pigment and

lardaceous exudation; under the pons varolii, in the medulla oblongata elongated tubercles of the size of hazel nuts. The left os petrosum was completely destroyed by caries, and there were tubercles in the lungs, bronchial glands, peritoneum, mesenteric glands, the right kidney, and the urethra on the left side.

In the cerebellum.—Nearly all the general observations relating to tubercles in the cerebrum and its membranes apply to the cerebellum. Its whole substance has occasionally been found invaded by a tubercular mass, and occasionally one of its hemispheres, so as not to leave a vestige of the proper nervous substance.

Carswell delineates a lobulated tumour as large as a hen's egg in the left lobe of the cerebellum, projecting above its surface, its consistence cheesy, of a yellowish-grey or greenish-yellow colour, presenting here and there anfractuous cavities, containing a grumous milky-looking fluid, the surrounding medullary and cortical substance softened where compressed by the tumour, the pia and dura mater adherent over the most prominent point of the tumour.—(Pl. iii, fig. 3.)

Cruveilhier also represents two tubercular masses in the cerebellum of a child, aged 9 to 10 years. They are deposited subjacent to the membranes, depressing the cerebellum, the tissue of which is unaltered, their colour, like that of most tubercles of the encephalic mass, is a greenish-yellow.—(Lib. xviii, pl. ii, fig. 1.) Also tubercular masses occupying the inferior surface of the cerebellum in a young person, aged 14 years; one of these, as in the former case, is circumscribed and susceptible of enucleation; the other appears to be formed of the substance of the cerebellum, of which only the debris remains.—(Fig. 2.) Also spheroidal tumours in the substance of the tuber-annulare, the surrounding medullary substance softened. —(Fig. 3.) Tubercles in the substance of the brain and an abscess the size of a pigeon's egg in the left lobe of the cerebellum is described by Lloyd.—(Lib. cit., p. 309.)

In the pituitary gland.—The deposit of tubercle is met with in this gland both in the form of crude grey granulation, and of yellow tubercle which softens and suppurates. It is a rare localization of the disease, and occurs only in combination with tubercle in other organs, especially in the lungs and brain. (Rokitanski.)

In the spinal cord.—Hasse describes the spinal cord as being for the most part natural in tuberculosis. Tubercles, however, sometimes occur. According to Rokitanski their principle seat is the cervical

and lumbar portion, sometimes occupying the white, sometimes the grey substance. Andral says they are most frequent in the cervical portion. As in the brain, they are accompanied with inflammation and red softening, or with yellow softening; sometimes several are grouped together, none exceeding the size of a millet or hemp seed; at other times one only, the size of a pea or bean, exists. I do not find a tubercular cavity in the cord recorded; Rokitanski never met with one. Rilliett and Barthez detected tubercles in the spinal cord of a child; there existed at the same time abundant deposit in the brain and its membranes; in all the cases tubercles were met with in other organs.

In the Nerves.—It is questionable whether tubercle has ever been met with in the substance of the nerves. The only case I find recorded which might be so regarded is by M. Bérard, who met with an instance in which the right phrenic nerve appeared to have its continuity interrupted by a blackish tubercle as large as a pea, and of a scirrhous consistence; there were some whitish streaks perceptible in the tumour, which seemed to keep up the continuation of the medullary substance; but the fact was not quite certain (Path. Anat., vol. ii, p. 803). Cruveilhier and Rokitanski found tubercle surrounding or adjoining the nerves; and the former, in one case especially, around the diaphragmatic nerve. The nerves are sometimes destroyed, or a solution of continuity is produced by the softening of tubercle around them; but the larger trunks resist suppurative destruction for a long time. M. Nelotan presented to the Anatomical Society of Paris the brain of a child 10 or 12 years old, referred to in the last section, in which all the nerves at the base presented a fine layer of tubercular matter irregularly deposited around their origins. When tubercles occur in these situations, they are always met with elsewhere.

B.—OF THE LUNGS.

THE PATHOLOGICAL ANATOMY OF THE LUNGS IN TUBERCULOUS ADULTS.

Of all the organs, the lungs are by far the most liable to local disease in tuberculous subjects, and there is no part of the science of medicine of greater importance to the practitioner than an accurate knowledge of their pathology in tuberculosis; it is paramount to an acquaintance with the physical and general *signs* of chest affections, inasmuch as, without it, we can have but a limited con-

ception of the thing *signified*. In the absence of this knowledge the greatest skill in auscultation may prove futile, and the chances of promoting the recovery of the patient by the resources of art may be rendered completely nugatory.

In former sections, the liability of tuberculous individuals to acute, sub-acute and chronic inflammatory affections of the mucous and serous membranes, and especially of the pleuræ and of the mucous lining of the bronchiæ, has been fully described. They are also subject to acute, sub-acute and chronic pneumonia, primary and secondary, but the deposit of tubercle is so constant an occurrence, and all other pathological lesions are so involved in the considerations which relate thereto, that they can only be treated of in relation to tubercle itself.

1. *Tubercle in the lungs* is the special anatomical element of tuberculosis pulmonalis or phthisis. It is developed in the subjects of tuberculosis under every variety of circumstances, and produces death in various forms.

On opening the chests of those who have died of phthisis, the lungs, for the most part, do not collapse as usual, and are enormously increased in weight. Under Dr. Boyd's observation the average weight, in a considerable number of cases of adult males, was 72·21 ounces; the standard average of weight when free from disease, according to Dr. Clendenning, being 46½ ounces. A corresponding increase of weight was also found in females. This increase is not due to the deposit of tubercle alone, but is partly produced in various combinations and degrees, by an increased quantity of blood in the vessels, the secretion of tuberculous pus, serous effusion, red or grey hepatization of the lung, or extravasation of blood.

All the *forms* of tubercle are developed in the lungs. They may be deposited rapidly or slowly, and they may either succeed to or lay the foundation for chronic or acute disease. When distinct, their number is extremely variable; sometimes, when a patient has died of some other disease, four or five are met with; in most cases they number many thousands; separated, when no other morbid product is present, by a simple zone of pulmonary tissue in a sound state. In this case—the early stage of uncomplicated tuberculization of the lung—the pleura maintains its transparency and integrity, the pulmonary tissue is crepitant around the tubercles, those which are placed superficially are somewhat raised under the pleura, and on incision the lung partially collapses, thereby ren-

dering the tubercle more salient and distinctly granular. Single tubercles in the lungs are never larger than hemp seeds; where they are described as larger a congeries must be understood. (Hasse).

Yellow and grey crude miliary tubercles rarely co-exist in the same lung, where they do, their deposition is referrible to distinct epochs.

When grey tubercular infiltration pervades the pulmonary tissue, it gives it a grey colour and renders it semi-transparent and dense, the areolar texture of the lung disappears, and on incision, the morbid structure presents a smooth, polished, shining surface; it may sometimes be compared with cartilage. There is almost always found, within the grey substance, dull or yellowish-white points, being incipient yellow tubercles, which ultimately invade the whole. In some subjects this transformation is nearly complete, and grey matter is found only interspersed among the tubercles. Grey infiltration is also common around softened yellow or grey tubercles and excavations, and it rarely constitutes the sole pulmonary lesion. The facts shew indisputably that whether in the miliary or in the infiltrated form, tubercle in the lungs is at first grey, and afterwards yellowish.

Yellow infiltration is found in the lungs in masses, generally dispersed, and paler and less distinct from the substance of the lung than ordinary crude tubercle; these masses are irregular and angular; they present the appearance of an infiltration into the pulmonary tissue, while the round tubercles are like foreign bodies which displace rather than penetrate it. It frequently occupies nearly the whole of a lobe, but even when it occurs at the surface it does not project, nor does it alter the form of the lobe; as its development progresses it becomes more yellow, and ultimately softens. Laennec considered that this infiltration always succeeds the grey infiltration, just as he considered yellow tubercles succeed grey granulations; but subsequent pathologists have shewn that such a transformation is not essential, the yellow matter, like yellow tubercle, being sometimes deposited from the very commencement. Rilliett and Barthez illustrate most satisfactorily both occurrences in the lungs of infants.

A dark coloured point is sometimes observed in the centre of tubercles in the lungs; this is believed to be a residue of the original contents, morbid or natural, of the air cells.

2. *The seat of Tubercle in the Lungs.*—The aggregation of tubercular matter in the lungs almost invariably, in the adult, commences in the upper lobes. Miliary tubercles are most frequently seated at a distance from the pleuræ, but in many cases they are as numerous immediately under the membrane as in the centre of the parenchyma, they are, however, generally most abundant in the posterior part; but that these circumstances have no relation to the disease in its essence, appears from the occurrence of numerous exceptions. In children, in acute cases, and in some chronic cases, the whole lung on one side, or a large portion of both lungs, appears to have received the deposit almost at precisely the same period. In explanation of the earlier occurrence at the apex of the lung in so vast a majority of cases, Carswell observes, as a general rule, tubercles are rarely met with in moving organs, and that the upper lobes have a very limited motion, in correspondence with the limited motion of the upper part of the chest, as respects its ascent, descent, and lateral expansion; at the same time, the lobules at the apex of the lung are the most permeable to air. Cruveilhier suggests that the mechanical pressure of the inner edge of the first rib upon the apex of the lung may exercise some influence.

Louis and Andral found tubercle more frequently in the left lung, Hasse in the right. It is not yet rendered certain that either is absolutely more frequently affected than the other.

With respect to the minute pathological seat of tubercles in the lungs, without entering into the anatomical distinction sometimes implied by the employment of the terms "air cells" and "pulmonary vesicles," we shall adhere to the former, as conveying, upon the whole, the more accurate notion of the structure of the lungs. Majendie, in 1821, appears to have been the first person who advocated the doctrine, that the air cell is the part of the lungs in which the aggregation of tubercular matter originally takes place; and although, as observed by Andral, when these cells are dilated and their walls thickened, the walls themselves present a peculiar yellow tinge—deeper in some points—and a number of yellow, round bodies, which are undoubtedly of a tubercular character—and, although there can be no doubt, as subsequently demonstrated of other tissues, that tubercle may aggregate in the areolar parenchyma of these organs—still the fact, as expounded by Majendie, has been confirmed by Dr. Carswell, M. Schröder, Van der Kolk, and more

recently by Mr. Rainey and others. The *earliest* microscopic indication of tubercle in the lungs, is a deposit of a certain quantity of a transparent or a greyish or yellow substance in one or more cells, sometimes completely filling and distending the cell; the small blood-vessels of the parietes, which circumscribe the tubercular matter, being still easily perceived.

The aggregation of tubercle sometimes takes place in a few only of the cells, but more frequently it fills all the cells forming one lobule, and in this case it adheres to the vessels, which soon disappear, and the whole lobule, after a time, presents the appearance of being wholly formed of tubercular matter. In some instances the yellow matter is moveable within the cells, and may probably be capable of being expelled from them, and it presents all the appearances of being secreted from the blood by the minute pulmonary blood-vessels. Mr. Rainey states that the tubercular matter is poured from the free surface of the pulmonary membrane, (which he regards as a very fine fibrous membrane), into the interior of the air cells, these becoming distended, and the septum between the contiguous cells at first compressed, their vessels being subsequently obliterated and the supply of blood to the diseased part cut off; a tubercle thus formed corresponds in size to the number of distended cells.

Tubercular matter is deposited in the same way, and at the same time, in the bronchial inter-cellular passages; their walls disappear in the same manner as those which separate one cell from another, and these passages becoming occupied by the morbid deposit, contribute to form a part of the tubercle; the smaller bronchial tubes also becoming distended with tubercular matter are involved in the general mass. (Lib. cit., p. 592).

Tubercles in the lungs thus originally assume the shape of the air cells, being somewhat acuminated in proportion as they project more or less into the bronchial tubes. When they have been of slow growth, are deposited in large groups, and occupy numerous cells of a lobule, they resemble the sprout of a cauliflower, the pedicle occasionally extending far into the bronchial tube. (Carswell, Tubercle, pl. i, figs. 1, 2, 3.) In the lungs of ruminating animals, the tubercular masses are often seen extensively plugging up the bronchial tubes.

They have never been found in the areolar tissue separating

either the lobes or lobules, a circumstance which has been referred to in proof of their seat being the pulmonary cells.*

Although, I believe, the pulmonary cells to be the earliest and the most frequent seat of tubercles in the lungs, the facts already recorded and the differences of opinion which have been entertained as to the precise seat of tubercle, may be advanced in favour of the opinion originally given by Andral, and adopted in this work (Ch. iii, p. 122), that they may occur in any tissue where nutrition or secretion is carried on.

Schröder van der Kolk observed, microscopically, that at the commencement of the formation of granulations in the air cells the air cell no longer contains air, and he describes the granulations as being originally constituted of cells full of coagulable lymph and firmer than the surrounding cells containing air, but the lymph distending them is so limpid that it is difficult to distinguish the cells in which it is contained from those which surround it, except by the resistance it affords to the finger. M. Rocheux believes that the tubercular matter is always solid from the commencement. M. Kuhn represents, as the commencement of the formation of tubercle in the lung, the production of globules swimming in a clear mucus, which is subsequently absorbed.† I have given a description of the intimate structure of tubercle from Vogel and Lebert, the more recent observers, in the general description of the morbid product (Ch. iii, p. 124), and this description applies to tubercles in the lungs as in other parts.

3. *The state of the vessels around Tubercle in the Lungs*—in their various stages of development, is a subject of great interest and importance. It has been especially investigated by M. Schröder, Van der Kolk, M. Natalis Guillot, M. Sebastian,‡ M. Valleix,§ and MM. Rilliett and Barthez, but unfortunately in this as in other parts of the pathology of tubercles, different views are entertained. M. Schröder and M. Guillot describe the capillaries of the pulmonary artery in the walls of the air vessels where tubercle is deposited, as becoming plugged up, obliterated, and destroyed by the compression of the tubercular matter; or, according to the

* British and Foreign Review, vol. vii, p. 553.

† Rech. Micr. sur la forme et la nature des tubercles chez l'homme. Mem. lu a' l'Acad. de Med., 1834.

‡ De Origine Phthiseos Pulm.

§ Consid. sur les lésions anatom. et sur la curabilité de la phthisie pulm. Arch. gen. 3 série, 1841, p. 153.

former, by an inflammation which extends from the more minute branches to the larger, producing the secretion of coagulable lymph; but this explanation has not been confirmed and is not generally admitted. The vessels by which respiration had been effected are replaced by a new vascular system, at first, according to M. Guillot, independent of the circulation, but ultimately anastomozing with the vessels of the greater circulation; they are supplied with bright arterial blood instead of dark venous blood. M. Schröder states that the new vessels are developed from the pulmonary artery, but instead of anastomozing with the pulmonary veins they empty into the intercostal and the internal and external mammary arteries, and their contents are returned by the corresponding veins; these vessels communicate by new and often very extensive branches with those portions of the lung which are now everywhere firmly adherent to the thoracic walls, a state of things often revealed during life by an extraordinary development of the sub-cutaneous net-work of veins in the sub-clavicular region. It has been objected to this, that it could only happen when the pulmonary and costal layers of the pleura adhere. M. Guillot describes the new vessels as forming a net-work around tubercles, sometimes visible to the naked eye, and resembling the vascular apparatus of the vitellus of the egg; a new set of vessels, at first independent of the circulation, but after a time they anastomoze with the branches of the bronchial arteries; and where there are cavities and adhesions, they communicate with the arteries of the chest. He states that the blood, derived from the greater circulation, returns by its usual channel, or by the pulmonary veins into which a coloured injection finds its way from the aorta, but these new vessels can in no way supply the place of the pulmonary artery, or subserve the purpose of the aeration of the blood. Hasse, however, deems it much more probable that the two circulations invariably remain distinct (p. 335). According to Guillot the new vessels become extremely numerous, and tubercles soften in proportion as they replace the capillary branches of the pulmonary arteries, but they do not penetrate into the substance of the tubercle.

In proportion as tubercles multiply, enlarge and soften, this vascular rete spreads, and after a time an entire lobe or a large portion of a lung becomes the seat of this adventitious vascular system, replacing the pulmonary artery; and although these new

vessels are developed around crude tubercles without penetrating them, the case is somewhat different, as will presently be described, with respect to cavities.

Thus, as remarked by M. Guillot, is established one of the most remarkable phenomena attending the development of tubercles in the lungs, the consequence of which is that in proportion as the tuberculization makes progress, the lungs, in opposition to ordinary laws, acquire increased capacity for *arterial* and lose it for *venous* blood.

Rilliett and Barthez take a different view of the vessels around pulmonary tubercles as observed in *children*. They state that around miliary tubercles there is a vascular net-work, but not around yellow or grey infiltrations or grey granulations. That when the lungs contain isolated grey granulations an injection penetrates easily either by the bronchial or pulmonary arteries into the pulmonary veins; that the vascular net-work communicates very evidently with the pulmonary artery and probably with the veins; that in grey infiltration the small bronchial arteries are obliterated, in which respect this deposit resembles the effects of chronic pneumonia, and is favourable to the opinion entertained by some that grey granulation itself is the result only of chronic pneumonia. (Lib. cit., p. 26.)

4. *The mode of distribution of Tubercle in the Lungs.*—When the development of tubercles in the lungs has been gradual, both lungs are generally assailed almost at the same time, though scarcely ever to the same amount. The deposit, commencing at the apex, gradually descends, presenting a descending scale of development downwards. Thus, in the upper lobe, one or more large cavities are met with at the apex, smaller ones inferiorly, and dense accumulations of tubercles which have undergone partial softening occur at the base. In the lower lobe the relations are the same. But this does not apply, according to Hasse, to the development of tubercle in the middle lobe.

That there is not an absolute law of development from above downwards is also shewn by the fact, that in two out of 123 cases Louis found numerous tubercles in the act of softening, exclusively in the inferior lobe. When both lungs contain tubercles, they are frequently in a state of grey granulation and crude yellow tubercle in the right lung, while they have attained the stage of softening in the left. Finally, the upper lobes of a lung, or the

upper portion of a lobe, may be tubercular in any of its degrees, the lower lobes, or the lower portion of a lobe, remaining healthy and crepitant.

The mode of distribution of tubercles in the lungs is influenced by the mode and period of their development. When they are miliary and equally dispersed, they have been formed rapidly; when, as just described, they progress from the summit downwards, they have been formed slowly. When they are infiltrated, they appear generally to have set in all at once in an acute form, as a variety of hepatization. Hasse remarks that they are for the most part limited, in the lungs of an individual, to a single one of these modes of distribution, but cases occur in which all are met with in the same lung, each however being obviously due to a distinct period of deposition.

Tubercles deposited in the lungs are subject to all the changes described in a former chapter, with many remarkable specialities in relation to the structure and function of the organ.

The phenomena presented by the process of softening and the formation of cavities, cannot be understood without a previous description of—

5. *The Morbid Complications to which Tubercle is liable when deposited in the Lungs.*—After death it is most frequently found to be accompanied with one or more of the following pathological conditions.

Pneumonia with consequent hepatization is the most common occurrence in tuberculous subjects. It is characterized by the ordinary morbid products of pneumonia, having a tubercular type. It may occur as the result of ordinary causes before tubercles have been deposited in the lungs or any other organ, or in consequence of tubercles acting as foreign bodies after their deposition, and during any period of their stages of development; hence it is either, as respect tubercles, primary or secondary. This is a part of the pathology of tuberculosis which the practitioner ought never to lose sight of; it may put a period to the existence of tuberculous individuals very rapidly, and even suddenly, particularly in the form of acute phthisis, when the tuberculous state of the blood is in the highest degree developed; or it may supervene in any stage of chronic phthisis, giving occasion to the softening of hitherto inert tubercles, or terminating life suddenly and unexpectedly, and long before the general dis-

ease has exhausted the individual; hence, like perforation of the pleura, it is one of the most fatal incidents which occurs to the subjects of tuberculosis.

In the greater number of cases tubercles once aggregated in the lungs keep up a constant irritation, and hence congestion, followed by inflammation, and both the congestion and the inflammation promote the further deposit, and the *maturation* of that which is already deposited. At the same time inflammation of the lung is not a necessary accompaniment even of *softening*. This inflammation, wherever it occurs, changes the whole face of the disease, inasmuch as it modifies in the most essential particulars the condition of the blood. So long as tubercles are crude, the tuberculous condition of the blood continues, with a less proportion of fibrine than in a normal state, but from the moment inflammation sets itself up the proportion of fibrine augments, and although it never reaches the amount of fibrine in the blood of healthy individuals becoming affected with pneumonia, it indicates a change in the state of the blood, which is attended with a corresponding change in the symptoms of the disease of the blood.

(*a*) *Primary Tuberculous Pneumonia*—produces a plastic exudation, differing from the ordinary exudation of pneumonia by its tuberculous qualities, and the disease may run its course, the exudation being absorbed, as in ordinary cases. Occasionally, however, as admitted by Louis, Grisolle, and others, primary pneumonia in tuberculous subjects is followed by tubercular infiltration, and all the consequences of the deposition of tubercle. According to Hasse this occurs more frequently in the male than in the female sex, and in persons from 18 to 25 years of age than earlier or later in life. Rokitanski terms it hepatization by a tuberculous product, which, instead of being absorbed or becoming purulent, passes through several phases of change, and ultimately becomes yellow tubercle.

(*b*) *Secondary Tuberculous or Intercurrent Pneumonia*—is a much more frequent occurrence than the former.

Louis found the results of pneumonia in the first stage, commonly occupying a limited space, in 23 of 123 cases; in the stage of red hepatization of various degrees, generally in the inferior lobe, in 18 cases. Of the latter, 9 were hepatized to a great extent; and 9 in the form of small, disseminated masses. He regards the invasion of the pneumonia in these cases as preceding

death only a very short time—a few days—and the occurrence as by no means peculiar to phthisis, having observed it, with much the same proportional frequency, in other chronic diseases.

Other observers, and particularly those who refer the softening of tubercles to inflammatory action, or "an inflammatory irritation" in the surrounding parts, describe pneumonia as a much more frequent occurrence. This form and degree of pneumonia is for the most part lobular. It has already been explained that tubercles may be deposited in an organ, and the patient may die of tuberculosis without the slightest evidence of inflammation, but the tubercles are very liable to act as foreign substances, and to excite inflammatory action in the surrounding tissues. The occurrence of pneumonia after the deposition of tubercle may also be referred to the increased susceptibility of highly tuberculous subjects to the ordinary causes of inflammatory diseases, as exemplified in early life, by the frequency of the various forms of external scrofula, ophthalmia, &c., and in later life, by pleuritis and other internal affections. This secondary tuberculous affection appears, as a remarkable peculiarity when compared with ordinary pneumonia, in the form of—

(*c*) *Lobular or Vesicular Pneumonia.*—It is for the most part after tubercles have congregated into masses that intercurrent irritation and inflammation of the surrounding pulmonary tissues ensue, the tubercles producing the effects of foreign bodies. The substances effused are not purely inflammatory, they are for the most part gelatiniform and tuberculous, and surround individual tubercles or congregated masses, leaving the remaining part of the lung healthy. It is sometimes not confined to the pulmonary cells immediately surrounding tubercle; it is not restricted to a number of distinct patches separated by healthy lung, but overspreads an entire lobule, or even a lobe. With this inflammatory affection the tubercular deposit extends, so as to involve an entire lobe or more; red or grey hepatization ensues, and the diseased part becomes of a reddish, greyish, or yellowish-white colour, thoroughly impermeable to air, and of a firm, brittle consistence; those tubercles which existed before the inflammation set in being softened. This vesicular pneumonia, not restricted to patches, often accompanies the deposit of tubercle to a very great extent, and precedes its fatal termination.

Without offering any opinion in this place on the question of

the primary or secondary character of the pneumonia which produces the hepatization and other characters, so conspicuous in that remarkable form of tuberculosis now generally known as—

(*d*) "*Acute Tuberculosis of the Lungs,*" I deem it most useful to describe the pathological appearances under this head, seeing that acute pneumonia as well as bronchitis has so much to do with it. One remark only is necessary, if the pneumonia be primary as respects disease of the lung, it is not so as respects the blood disease, the pneumonia supervenes on a tuberculous state of the blood of the highest intensity.

The following is Hasse's description of the *post mortem* appearances in cases of acute tuberculosis of the lungs. In very marked cases, one or both lungs from apex to base, are uniformly loaded with isolated, miliary tubercles, mostly yellowish and soft, but occasionally greyish and more solid, the colour and consistence depending upon the degree of irritation produced. The yellow and soft ones are found in the centre of a group of *red or grey hepatized cells,* while the grey ones are imbedded in a texture saturated with bloody serum. The organs are greatly tumefied; they do not collapse when the thorax is opened, are very dark coloured, preternaturally soft throughout, and gorged with blood and serum. The tubercles have everywhere the same character—a proof of their simultaneous origin; the inflamed, if not hepatized parenchyma surrounds them for the most part to the extent of a line, but not much further, so that notwithstanding their number, pulmonary cells still permeable are everywhere cognizable. The bronchial canals are of a deep red colour, often passing into violet. Adhesions of the pulmonary and costal layers of the pleura are never met with unless of earlier date. These appearances, from the previous history of such cases, and from their obvious character, have evidently been produced very rapidly, probably in two or three weeks. When the disease has been slower in its course the tubercles are less uniformly miliary, and are united into groups; they are then also more densely crowded at the apex, and in the superior lobe generally, than at the base of the lung.

Where tuberculosis in this form has run a rapid course, indicating its highest degree of intensity, its seat, as a disease of the blood, according to the description given by Hasse, is very remarkably illustrated. When very rapid, tubercles may not be de-

posited in any organ but the lungs—a few sometimes occurring on the pleura and other serous membranes, and in rare instances beneath the arachnoid membrane. More frequently they are found in great numbers in the spleen, a few on the surface of the liver, also on the cortical substance of the kidneys; and the supra-renal capsules have been found so replete as to have increased to thrice their ordinary thickness. The mucous membrane of the intestines is seldom affected, except occasionally in individual crypts of Peyer's glands. The greatly altered state of the blood is rendered obvious—by its fluidity in the blood vessels and the heart; by its imbibition in the coats of the blood vessels and in the parts adjacent to the larger veins; by the softening of many organs, especially the heart and mucous membrane of the stomach; by all the solids and fluids of the body suffering a change, inasmuch as a rapid exosmose of serum occurs, and liquid effusion tinged with blood is found in all the cavities; and by the corpse being liable to unusually rapid decomposition. In two instances Hasse found globular coagula containing pus-like fluid in both ventricles of the heart. (Lib. cit., p. 321.)

These pathological appearances differ so much in many respects from those observed after the ordinary course of tuberculosis, that they clearly indicate some remarkable speciality; at the same time they are replete with signification in reference to the nature and causes of the disease.

(*e*) *The results of Chronic Pneumonia.*—The vexed question among pathologists seems to turn upon the nature of some of the products hitherto described; one class referring them to tubercle purely considered, and the tuberculous disease of the blood, and even denying the existence of such a thing as "chronic" pneumonia; another class referring them to inflammation, and all-but denying that the specific anatomical element—tubercle—has anything to do with it; a third class adopting a middle course. This subject has been treated of in the general description of tubercle (p. 139), and there are only one or two points in relation to the lung which here require notice.

Hepatization of the lung in tuberculous subjects, according to Hasse again (p. 224), is red or grey, and also numerous shades and varieties of tint of which these two are the original type, the colour depending upon accidental circumstances. The grey induration is most frequent, and has sometimes been called "white hepatiza-

tion;" the characters by which it is distinguished from grey tubercular infiltration have been detailed (ch. iii, p. 132-3).

The transitions and combinations are represented by Hasse as numerous (p. 225). At the part affected, the lung is distended, preternaturally heavy, completely impermeable to air, the bronchi mostly choked up with a solid whitish matter, the natural texture of the lung no longer distinctly traceable, the whole mass hard, incompressible, neither friable nor easily penetrable by the finger, but yet fragile and easily torn, the cut surface is smooth, looks grey here and there, inclining to yellow, diversified with separate white stripes and arborescent patches of black pigment, but devoid of the granulations of acute pneumonia; nothing exudes on incision, and but a small quantity of turbid greyish fluid on pressure. It is mostly the inferior lobe of one or both lungs that is thus affected, and as this pathological state proceeds from below upwards, it meets the tubercular process advancing in the opposite direction. In the examples seen by Hasse, the process invaded the lower portion of one lung only, whilst the tubercular affection was seated in both.

This morbid condition is referred by Andral, Hasse, Hope, and other pathologists to chronic pneumonia, although, as before stated, doubted by others. It scarcely ever arises out of ordinary acute pneumonia, but most frequently appears to coincide with the formation of tubercle. In it the genuine product of inflammation appears to be mingled in various degrees with heterologous materials. It is distinguished from common pneumonia by the texture of the lung not being softened, but on the contrary hardened.

The following explanation of this condition of the lung appears to me to be the true one. A purely local inflammation sets itself up in a subject affected with a tuberculous state of the blood, in whom the blood disease may or may not have previously proceeded so far as to deposit tubercle. The morbid products of the inflammation are *tuberculous*—nay, more—they are sometimes actually *tubercular*, as shewn by the yellow stripes. The effect of the local disease and its concomitants upon the general habit is to precipitate the blood disease; hence, in many cases, together with the tuberculous inflammation in one part of the organ—that most prone to pneumonia, tubercles are deposited in another portion of the lung—that most prone to tubercular deposit. If these tuber-

cles excite inflammation, the morbid product is of the same tuberculous character, and may even contain tubercle.

(*f*) *Extravasation of Blood.*—This is met with in tuberculous lungs under various circumstances. 1. Fluid or clotted blood may be found in the bronchial tubes, without any evidence whether it came from the parietes of the tube or from the pulmonary parenchyma; or there may be inflammation and ulceration of the mucous membrane; or it may be extravasated under the mucous membrane; or it may occur both in the tube and under the mucous membrane; or it may have proceeded from a cavern. 2. Blood may be found in the uninjured pulmonary tissue through which it has infiltrated (infarction) — one of the most common forms of extravasation—frequently attended with hyperæmia of the lung terminating in rupture of a vessel, the blood being effused into the air-cells without any laceration, and remaining there in a coagulated state. 3. Blood may be effused from laceration of the tissue of the lung (pulmonary apoplexy). The extravasation from either of these causes may terminate in the local development of tubercles in the lungs. (Wunderlich.*) 4. Blood occurs in pulmonary caverns and bronchial tubes from a rupture of a vessel in the parietes, or the breaking of a cavernous band; the vomicæ and the bronchial tubes may be filled with coagulum, and frothy blood may be found in the trachea and larynx.

Extravasation of blood into the pulmonary textures may be met with at any stage of tuberculosis pulmonalis, but is chiefly observed where tubercle has been rapidly developed in connection with inflammatory action, or where the lung is replete with densely clustered tubercles. (Hasse.) The blood in many instances is poured out because the pulmonary veins, being compressed by the multitude of tubercles, are prevented returning the whole supply. (Carswell.)

In one case Louis found a cavity at the apex of the lung, as large as a moderate sized apple, filled with a firm mass of fibrine of a red colour, and apparently in part *organized;* it was invested with a white, rather fragile, false membrane, giving off septa which converged to and united at a central point. This false membrane was distinct from and scarcely adhered to that of the cavity. From the auscultatory signs there was reason to believe that the effusion took place about four days before death. (Case ii, Syd. Ed.)

* Brit. and For. Rev., Jan., 1852.

(*g*) *Emphysema.*—Vesicular emphysema is a frequent pathological occurrence in tubercular lungs; it occurs in chronic cases, generally in a diffused form, in the fore-part of the chest, and in the upper lobe.

Emphysema appears to occur in the early stage of the deposit of tubercle. It is produced by the tubercular matter disseminated through a portion of lung compressing the minute bronchial tubes. The inspiratory powers are strong enough to inhale the air through the compressed twigs, but the expiratory forces are not strong enough to return it. The surplus air expands and overcomes the elasticity of the pulmonary cells, and forcible expiration, as in coughing, compresses the vesicles, and causes them to give way.

The portion of lung actually emphysematous rarely contains tubercles, which appears to shew that dilatation of the air-cells forms an obstacle to the development of this product and to the progress of this aggregation. The fact that emphysema is almost always found in lungs having the characteristic marks of recovery from phthisis appears also to shew that it may even constitute one of the conditions under which the cure of phthisis takes place. It has been said that a great extent of emphysema will preclude the deposit of tubercle, although a limited extent may fail either to prevent or to arrest it; it is, however, rarely of great extent, but it is liable to come on very rapidly, and may not always be detectable by physical signs.

In the autopsy, emphysema is met with in the upper part of the lungs in conjunction with cicatrized and collapsed portions. The healing process, by absortion of the more liquid parts of tubercles and of tubercular abscesses, by shrivelling of the remainder, by cicatrization of the ulcers, and obliteration of the blood-vessels and bronchial tubes, tends to produce a vacancy in the space within the thorax, and in that portion of the pleura corresponding to the diseased portion of the lung; which vacancy is filled up more or less completely, although very gradually, by the sinking of the walls of the chest, but more immediately and with greater rapidity by dilatation of the air-cells in the still permeable portions of the lung. Sometimes this latter process occurs to the extent of preventing the shrinking of the parietes of the chest, and has even been known to cause a vaulted rise below the clavicles. In these effects we find the equal or unequal pressure of the atmosphere, within

and without the chest, acting as compensating forces. (Hasse, lib. cit., p. 313.)

Rilliett and Barthez attach no importance to emphysema in the tuberculosis pulmonalis of children; they met with it, but, as it appeared to them, less frequently than in other pulmonary diseases, and they consider that it has no relation to tubercle.

(*h*) *Œdema of the lung.*—I believe this occurs more frequently than is recorded, and that it has often been overlooked; it may be general and passive, and result simply from the watery condition of the blood in tuberculosis, or it may be more active or inflammatory. When resulting from disease of the kidneys, the urine being albuminous, it is an occasional cause of premature death, the lungs being tuberculous only in a slight degree. Rilliett and Barthez remark, that a serous congestion or true œdema coincides with the deposit of tubercle in children, and may be produced by deposit in the lungs, but it much more frequently depends upon the compression of the vessels by the enlargement of the bronchial glands. (Lib. cit., p. 241.)

(*i*) *Gangrene of the Lung.*—This sometimes occurs in consequence of compression and the obliteration of the blood-vessels, owing to the solidification of the lung from tubercular infiltration; it is characterized by a highly and peculiarly offensive odour, and the lungs are very much heavier than usual. It is well illustrated in Carswell—(Pl. iv, fig. 1.) A portion of lung forming the parietes of a cavity is also sometimes cut off from the circulation, slowly mortifies and sloughs away, the slough being wasted away within the cavity or expectorated.

6. *The destructive progress of Tubercles in the Lungs.—Softening:—Liquefaction:*—When tubercles are already deposited in the lungs, and the blood continues tuberculous, the destructive tendency too generally prevails. I have already very fully described the result of that tendency in tubercles generally (ch. iii, p. 134). In the lungs, they first extend themselves thus:—Some of the air-cells in the vicinity of the tubercles already aggregated may be observed to contain only a small quantity of the materies morbi, others to be completely distended with it, although in the early instance their vascular walls remain entire. Between some of the cells the vessels then become partially obliterated, and in the septa, if the quantity be sufficient to compress the capillaries

and cause their absorption, the vessels disappear, nothing remaining but the pulmonary membrane, which is also absorbed or mixes with the tuberculous matter, and on the breaking up of the tubercle is ejected from the lungs in the expectoration, in which it can be detected by the microscope. Thus, as a tubercle in the lungs increases in size, the central part becomes further and further removed from the bloodvessels and blood from which its material has been secreted, and consequently the central parts lose any degree of vitality which they may possess, and acquire the greatest tendency to become softened from physical causes; in this way the softening commonly begins in the *centre* (Rainey). Laennec, Louis, Schröder, Van der Kolk, and others, regard the commencement of softening in this point of view.

The softening of yellow infiltration in the lungs occurs precisely in the above manner. On close observation the centre is found to become more humid, soft and greasy to the finger, like new cheese, and these qualities increase until it resembles thick, inodorous, yellow or greenish pus. When in this liquid condition, it sometimes separates into two parts, one fluid, colourless and nearly transparent, the other curdy or grumous.

Hasse lays greater stress on the *peripheral* softening; he states that there ensues upon the deposit of tubercle in the lungs more or less irritation of the surrounding textures, produced by the tubercle as a foreign body, and followed by inflammation and suppuration, which reacting upon the tubercles cause them to soften from their periphery inwards, and ultimately to become removed by expectoration. At the same time he admits that a spontaneous breaking up of the cells of a tubercle in the lung may cause the central portion to soften first.

Post-mortem examination shews that in ordinary cases the softening takes place first in the tubercles at the summit of the lung, and proceeds from above downwards; this course being directed, as it were, by the progress of the original deposit. It has already been stated, that around crude tubercle the pulmonary tissue maintains its integrity, but this is not the case after softening commences. The pulmonary vessels become more and more obliterated, the vascular net-work of new vessels, already described, becomes daily more developed, adhesions between the lungs and pleuræ by means of false membranes augment the sphere of the new circulation, hyperæmia, congestion and inflammation of the

surrounding parenchyma set in, and various kinds and degrees of induration are produced.

After tubercles in the lungs have softened, they are discharged, and cavities are formed, which spread by successive tuberculization, softening, breaking down, removal of their contents and walls in a regular peripheral progress, and the coalition of two or more cavities, previously separated, into one larger cavern.

7. *Tubercular Cavities in the Lungs or Vomicæ.*—Vomicæ are either: 1, Pulmonary: 2, Pleuro-pulmonary: 3, Broncho-pulmonary: 4, Broncho-pleuro-pulmonary. All that specially relates to the three latter have been described in former sections (pp. 198, 235, 236); the details belonging to the first are in general applicable to the whole.

(*a*) *Their seat.*—The most frequent seat of vomicæ is the summit of the superior lobes of the lungs; they sometimes occur on one side of the chest only, tubercle on the opposite side being still crude, or in a state of softening; more frequently, before the termination of the disease, they are formed on both sides. They are met with in the lower lobes, and even at the base of the lung, but are then more numerous and larger at the summit. Proceeding from above downwards there are most frequently found in successive layers: 1, Cavities: 2, Softened tubercle: 3, Crude tubercle: 4, Semitransparent grey granulations: 5, Crepitant lung. The explanation of this already given is, that the tubercle had been deposited progressively from summit to base, and these different states indicate the progressive development of the morbid product. The cavities are seated either superficially under the pleura, or in the interior of the lung; in the first and least frequent case their tendency is to open into the pleural sac, an event usually prevented by the adhesions already described (p. 192); in the second and much the most common case they open almost exclusively into the bronchia. Large excavations are generally seated more towards the posterior than the anterior surface of the lungs, where they extend to the interlobular fissure, or even communicate with similar cavities situated in the lobe below. (Louis.)

(*b*) *Their shape and dimensions.*—While small they are spherical, but afterwards their shape is very irregular, arising from the softening of the neighbouring parts proceeding more rapidly in one direction than another. They vary greatly in size. They are met with from the size of a pea to that of an orange; and may

even occupy the whole lobe of a lung, the pulmonary tissue being transformed into a large pouch with very thin walls. The most frequent case is, where several cavities communicate together, constituting one unequal and often sinuous excavation, with fistulous tracts, and very irregular in form, size, and direction, but terminating in one or more ulcerated bronchi.

"'Professor Lizars has in his collection a very valuable specimen of a lung entirely excavated: nothing being left but an empty sac: the history of the case is quite complete. The man recovered, and was able to exist and support himself by manual labour, and died ultimately of typhus fever, unconnected with pulmonary complaint. I cite the above case, as I am convinced that many practitioners think a recovery from phthisis impossible.'" *

(*c*) *Their number.*—Vomicæ are generally numerous; each larger cavity resulting from the union, as before described, of several smaller ones; a single cavity is a comparatively rare occurrence. A tubercular cavity is almost always surrounded by crude miliary tubercles, but Louis gives one case where no other alteration existed. (Obs. iii.)

(*d*) *Their contents.*—Pulmonary caverns may contain air only, or solid or liquid substances. Most frequently a thick, viscid, purulent fluid is found, containing whitish clots of softened tubercular matter; sometimes pus of a more genuine quality, or of a dirty ash-grey colour, or tinged red with blood. The expectoration of these fluids during life has led, in all ages, to the affection being called "ulcers of the lungs." Sometimes the fluid exhales a very fetid odour, and M. Louis remarks, that this odour is independent of the size of the cavity or the presence of atmospheric air—in one case only he found mortified flakes of grey matter. When the cavities are recent the fluid is sometimes yellowish. It is in part a secretion from the parietes of the cavern, and in part detritus produced by the destruction of tissues and their mechanical admixture.

Sometimes fragments of the pulmonary parenchyma are found isolated or still attached to the walls by a fine pedicle. Louis observed this but once; Andral several times—and he considers they were the remains of bridles which had traversed the cavities. Louis once met with a fibrinous concretion, previously described, of considerable consistence enveloped in a false membrane, within

* Dr. Wilson on Pulmonary Consumption. Lancet, 23rd January, 1842.

a cavern which might have contained an apple of moderate size. Cavities also sometimes contain fluid or coagulated black blood, tubercle, pus, mucus, calcareous or melanotic matter.

(*e*) *State of the Bronchial Tubes.*—These are destroyed very early in the progress of the formation of a vomica; as generally believed by the pressure of the foreign substance. They are never met with in the tubercular mass which precedes the formation of the cavern, and are cut clean across almost always perpendicularly to their axis at the point where they open into the cavern. The colour of the lining membrane in the portions of the tube in the neighbourhood of caverns is sometimes natural, at other times it is bright red, and this is generally attributed to the passage of the softened tubercular matter and other fluids. The bronchi are at the same time often thickened, dilated and ulcerated.

But this open state does not exist in the earliest stage or while vomicæ are very small, both the vomicæ and tubes, particularly the simply membranous tubes, are then filled with the different plastic or non-plastic materials; and even in the later stages, the presence of a clot, mucus, imperfectly liquefied tubercle and the like, may occasion temporary obstruction, and in these instances the re-opening of the outlet may suddenly fill the larger air passages and produce death by suffocation.*

(*f*) *The Parietes of Caverns.*—These are constituted of the different anatomical elements which enter into the structure of the lungs. They are unequal, anfractuous, and often cast off bridles or columns of condensed pulmonary tissue, generally infiltrated with tubercular matter; which bridles traverse the caverns and bear some resemblance to the fleshy columns in the ventricles of the heart. These bridles are thinner towards their middle than at their extremities; Bayle once found a vessel permeating one of them; Louis met with five instances of this; Andral and Tonnelli with other instances; they shew the great destruction which has taken place in the pulmonary substance. When tubercle is once discharged, so as to form a cavern, the parietes may consist of naked pulmonary tissue or may be quickly lined with a slightly adherent soft false membrane. This membrane existed in three-fourths of Louis' cases.

But the walls of the cavern are rarely smooth and formed only of healthy condensed pulmonary tissue. Laennec observed it four

* Hasse from Andral, Clin. Med., vol. iv, obs. iv.

or five times only in twenty-four years, and Louis met with only one case. The denuded pulmonary parenchyma is almost always indurated, greyish, infiltrated with grey transparent matter or filled with grey granulations, crude tubercles, or melanosis. When the gelatiniform infiltration exists (p. 126) the portion of lung which surrounds the cavern becomes greyish, indurated, and presents, on incision, a smooth polished surface and homogeneous texture, and the other characters which this form of infiltration assumes. This is very common around caverns. Sometimes grey granulations or yellow tubercles are found disseminated in the portion of lung which constitutes the shell of the cavern, the parenchyma maintaining its healthy character in the intervening spaces. In other cases the pulmonary tissue is condensed, indurated and deep brown or black from melanotic infiltration. Sometimes it is surrounded with the different degrees of red or grey induration already described, and more frequently still with that variety of grey induration which has been attributed to tuberculous chronic pneumonia. Thus the walls of caverns are composed of various elements. 1. The healthy pulmonary parenchyma. 2. The products of tuberculous inflammation developed around the cavern. 3. The deposit of tubercle around the cavern. 4. Tuberculous secretion on the internal surface of the cavern.

The pulmonary vessels before they are completely obliterated, while their tunics are replaced by tubercular deposit, covered with remnants of lung and invested with a purulent crust, remain upon the walls of the cavities or traverse the cavities in the form of bands, as above stated, and in rare instances these vessels give way, from attenuation before their complete closure, and give rise to extravasation of blood.

Nerves have been traced by Schröder van der Kolk to the walls of a cavity, where their minute fibriles become swollen, and the neurilemma reddened; beyond this they blend with the morbid textures in the parietes and are lost.

(*g*) *Their False Membranes.*—On the internal surface of caverns there is found a soft, friable, white or yellowish unorganizable matter, resembling concrete pus or softened tubercle, easily scraped away with a scalpel; since, in the first instance, it contracts no adhesion to the pulmonary tissue, being merely deposited on its surface. Below, or externally to this, a layer forms of semi-transparent greyish fibro-cellular membrane, intimately adherent to the

pulmonary tissue, to which the term false membrane is especially applicable. After a time this fibro-capsule gradually becomes thickened, vascular, and organized, and, here and there, patches of greyish-white, semi-transparent, semi-cartilaginous substance are observable, which gradually uniting, become a complete lining to the cavity, except that the lining appears to terminate by continuity of substance with the internal membrane of the bronchiæ opening into the cavern. (Laennec). The substance of this cyst maintains a white, pearl-grey or reddish tint; the internal surface is of a red colour, and is by some described as velvety, consisting almost entirely of newly formed blood-vessels, but whether produced by a new development of vessels, post mortem imbibition, or the formation of a membrane analogous to the mucous membrane of the bronchial tubes, with which it is described as continuous, does not appear to have been definitely determined. According to M. Guillot, the vessels of new formation, already described as stopping short around crude tubercles without penetrating their substance, exist in the walls of caverns, and frequently extend into the false membranes which line them, and into their prominences; they ramify abundantly, and give colour to the bands which so frequently stretch from one point to another of their parietes. If a portion of a cavity be placed under water, after all mucous and purulent matter has beense parated from its surface, this surface is seen studded with tufts of new vessels, which, taken together, represent a sort of villous structure as observed with a common lens; these bronchial tufts bring the arterial blood, derived from the aortic circulation, into contact with the atmospheric air.

8. *Curative processes in Tuberculization of the Lungs.*—The curative tendency in the lungs is the same as elsewhere, and has been fully described in the third chapter, but it assumes various specialities referrible to the peculiarities of structure and function of these organs, and the consequent modifications in the development, form and effects of tubercular deposit. M. Roget has described four forms of the cicatrization of cavities.* M. Boudet describes five modes of cure.† Although the whole of these modes are not admitted, and some of the distinctions are founded only on the extent to which the curative process has gone, the process, as a whole, will be best understood by describing them seriatim.

* Essai sur la Curabilité de la phthis. pulmon; Arch. Gén. 3 ser., t. v, p. 289.

† Recherches sur la guer. natural. de la phthis. pulmon., p. 8, 1843.

Hasse lays down two conditions as indispensable to perfect cicatrization. 1. That there be no great amount of tubercle present. 2. That the incipient softening be not, as it usually is, attended with the continued deposition of tubercle. From all the facts, I infer that one condition only is absolutely indispensable, viz., that the blood cease to be tuberculous.

(*a*) *Absorption.*—The possibility of the absorption of tubercle in the animal economy has already been admitted (p. 139, ch. iii). Boudet regards the change into an oval or elliptical form, sometimes observed, as an evidence of the commencement of absorption. Fournet is the author, of all others, who has brought forward the most arguments in favor of its absorption from the lungs while in the incipient or crude state. Almost all those pathological appearances which Laennec, Bayle, and other observers, have referred to the cicatrization of cavities, this author advances as proofs of the absorption of tubercle in their earliest stage; but his views have been before the profession for some time, and have not been acquiesced in. When tubercles have remained latent in the lungs for an indefinite period or have passed into a cretaceous state, their aqueous, and in the last case their animal parts must have been absorbed.

(*b*) *Atrophy.*—This may occur among miliary tubercles. They are converted into hard, very small, bluish-grey or black nodules, which are incapable of any further development, and in the end disappear gradually. Whether larger tubercular deposits can undergo a similar metamorphosis is problematical.*

(*c*) *Cretification.*—This occurs in the lungs, as described in this work at page 142. It is the most frequent mode by which crude tubercles and tubercular infiltration are rendered innocuous. Wunderlich holds that the chalky mass from being triturable and sandy becomes studded with sharp spiculæ, as hard as bone, which mass neither exerts any disturbing influence on the adjacent lung nor on the organism, and that it is very probable that even this fragment becomes disintegrated and disappears; but this fortunate mode of termination is often frustrated by the circumstance, that while some of the tubercular deposits favourably situate for this process are healing by cretification, the disease is advancing in other parts of the lungs. (Lib. cit., p. 114.) Another explanation

* Brit. and For. Rev., Jan. 1852, p. 113.

of the appearances is, that the qualities of the blood are from time to time altered.

(*d*) *Sequestration.*—This is a mode of reparation of tubercle in the lungs which consists in the development of a membrane around the morbid mass while it is still crude or merely softened, the formation of the cysts being coeval with the tubercle, and the latter being rendered innocuous by it. Although admitted by M. Boudet, and, if I understand him, by Hasse also, it does not rest upon any very clear proof. It appears to be an opinion entertained of the interpretation which ought to be put upon some of the phenomena about to be described belonging to the cicatrization of cavities.

(*e*) *Cicatrization, the cavity remaining.*—These are the fistulous cicatrices of Laennec. The cavity may be simple or multiple; round; of very variable capacity; empty, or nearly so; communicating with one or more bronchi; sometimes closed on all sides, and lined with a false mucous, fibrous, or fibro-cartilaginous membrane, and sometimes with only the rudiments of a false membrane. This state of a cavity appears to result from a modification of the disease of the blood after tubercle has been deposited, and produced its local effects; the resumption of the healthy state of the blood enables the false membrane to secrete organizable plastic lymph instead of tubercular matter. Sometimes the cicatrix does not line the whole of the parietes of the cavern, and a portion of the parenchyma may be seen in the intervening space, but most frequently it is complete. When it dates long antecedent to death, it is greyish, solid, semicartilaginous, and crakles under the scalpel. Laennec, Andral and Rogée, record remarkable examples of these cartilaginous cicatrices. Sometimes patches of ossification occur in the cyst. Sometimes the bronchial tubes, as they enter the cavity, are so dilated that they form pouches which may be mistaken for diverticula of the principle cavity; or the bronchial tube may contract as it reaches the cavity and become completely obliterated. Andral gives a case where this double alteration occurred. (Clin. Médic., p. 370.) The obliterated bronchial tube may form a fibrous or fibro-cartilaginous membrane running within the cicatrix. These tubes may be open by a very minute, elongated, scarcely discernible passage, or they may be obstructed by a calcareous or cartilaginous

concretion. Thus the bronchi may be dilated, contracted, or completely obliterated around a cicatrix in the lungs.

The pulmonary tissue around a cicatrix is often healthy and perfectly crepitant, but in a great proportion of cases it is indurated and infiltrated with black matter. At other times grey granulations, or crude yellow tubercles, or small chalky concretions, are disseminated around; and nothing is more common than to find adhesions of the pleura pulmonalis to the pleura costalis in connection with the cicatrix. At the summit of a lung containing a cicatrix, a more or less marked depression is frequently observed, its surface being hard, unequal, crossed by projections, and in a manner crumpled; or the ridges are united in a common centre, at which point adhesion between the pulmonary and costal pleura exists; these depressions depend upon the loss of substance of the lung, and the consequent contraction which it has undergone. Laennec never saw a pulmonary cicatrix without puckering of the corresponding surface of the lung.

Hasse describes more particularly the salutary effect of a return of the blood to a healthy state over cavities in the lungs. The internal membrane is converted thereby to a pus and mucus secreting structure, the parietes beyond, instead of continuing to soften and liquefy, become saturated with coagulable and organizable substances, and the cavity seems to shrivel and contract; but if the blood disease returns, or is aggravated by any cause, the secretions become mingled with tubercle again, the false membrane liquefies, the cavity gains size, and the lung becomes more and more deeply involved (p. 333).

Cruveilhier represents, in his 32nd book, plate v, a vast cavern cicatrized, occupying the superior lobe of the lung. There are numerous bridles traversing it, and producing a resemblance to the interior of the ventricles of the heart. The cicatrization was perfect; the walls presenting the appearance of accidental mucous membrane; each bridle contained in its substance an air-vessel and blood-vessels; the cavern communicated with several large bronchi, but did not contain mucus—it was an *air-sinus;* other small caverns, cicatrized, were observed in different points of the superior lobe.

(*f*) *Cicatrization by a fibro-cartilaginous substance, no cavity remaining.*—Laennec was struck with the frequency of this kind of cicatrization, which he regarded as the most simple and most

frequent mode adopted by nature to cure an ulcer in the lungs. It consists simply, of a fibro-cartilaginous laminar deposit. Sometimes a very small cavity remains, the last vestige of a cavity; which in other cases contracting on itself is finally obliterated. In the cases related by M. Andral, the fibro-cartilaginous lamina was traversed by large contracted or obliterated bronchi. Laennec once found a lamina of this kind doubled on itself at one of its extremities, so as to constitute a cavity full of dry, friable tubercle (case 23). As the cavities formed of this cartilaginous substance contract, their walls ultimately come into contact, so as to form merely an elongated, solid cicatrix formed of cartilage, against which whitish lines, the remains of the obliterated bronchi, transformed into fibro-cartilage abut. This form of cicatrization is now regarded as the ultimate result of the former mode in which the tuberculous cavity is still lined with a fibro-serous or cartilaginous false membrane.

(*g*) *Cellular Cicatrices.* — This is the least frequent mode in which the result of cicatrization in the lungs presents itself. In a body examined by M. Andral, the lung presented at one point a simple line or fibrous intersection, and at another a thin plate formed of a similar tissue, to which several dilated bronchiæ were attached. (Chin. Med., p. 372.) In Laennec's 24th case there was a line of white condensed "cellular" tissue—6 lines long by 3 or 4 thick—into which bronchial tubes the size of a crow's quill terminated, but it occurred in the body of a man 65 years old, and there was not a trace of tubercle in the lung. There is considerable doubt as to the nature of these cellular lines or patches.

These latter modes constitute the *obsolescence* and *cornification* of Rokitanski (ch. iii, p. 139). As respects these curative processes generally, Hasse remarks, the inflammatory exudation upon which the obliteration and shrivelling of the pulmonary cells depend often involves the whole apex, if not the entire upper lobe, the collective bronchial tubes degenerating into threadlike ramifications; the parenchyma is converted into an almost cartilaginous mass, impervious to the air, very scantily supplied with blood vessels, and presenting when cut a smooth, glistening surface. Obliterated pulmonary vessels, closed bronchi, cicatrices, and finally, parenchyma drenched with plastic materials, are scarcely to be distinguished from each other, and the whole adheres very firmly, by means of the thickened, semi-cartilaginous pleura, to the sunken walls of the chest.

In the most perfect examples of recovery, not a vestige of the residue of tubercles can be detected. Even the pleuritic adhesions at the apex begin to loosen, forming lengthened threads or thin bands, and finally vanishing altogether; the fact of their existence being afterwards shewn by their semi-cartilaginous plates upon the surface of the top of the lung, which in different spots are more or less puckered in a radiate manner. Hasse met with three such cases.

(*h*) *Cicatrization — the cavity containing cretaceous matter.*— This transformation is described generally in the chapter relating to tubercle. When it occurs in a cavity of the lungs, it is frequently nothing more than a modification of the modes of cicatrization already described. The change from tubercular to cretaceous matter generally commences in the centre of the mass. M. Boudet observed microscopically small opaque granules, the commencement of the chalky deposition; and in proportion to the increase of this, the tubercle diminished and the lung retracted on the cavity. When the change is complete, the chalky matter is contained in a fibrous or fibro-cartilaginous cyst, with a small surface communicating with dilated or contracted bronchi, and surrounded, like the cavities described under the last head, with pulmonary tissue indurated, infiltrated with tubercle, and attended with puckerings, pleural adhesions, depressions, and cartilaginous patches.

Occasionally, particularly in young individuals, the calcareous deposit takes place at the periphery, so that the outside is alone changed into a calcareous crust, while the central part retains its softness; sometimes it is thrown out at intervals, producing a series of distinct, hard, super-imposed layers; again, a considerable portion of a lung may become reduced by obliteration and shrivelling to a hard shell, holding in its centre a chalky tubercle no larger than a pea. (Hasse.)

(*i*) *Transformation of Tubercle in the Lungs into Melanotic Matter.* —The tubercle, during the deposit of black pigment, is consistent and greasy to the touch; it presents on division a number of striæ or black spots, and a layer of carbonaceous matter at the circumference; the spots extend and the striæ enlarge, the black circle at the same time contracting, and ultimately the tubercular mass becomes almost entirely black. Small pulmonary tubercles, the size of a pin's head, may be buried in a melanotic mass, and small

encysted granules, resembling tubercles, are sometimes found in the vicinity of tubercle undergoing the melanotic degeneration.

The melanotic matter occurs, during the healing process, not only in the parts adjoining calcareous tubercles and cicatrized cavities in the lungs, but in entire masses of extensive induration of the upper lobes, which are densely loaded with it, giving a slate grey or bluish-black tint; and in the shrivelled cavities of nearly obliterated vomicæ it occurs as a smeary blackened mass. It may be diffused or circumscribed in the lung, and has a deeper tint at the summit than in any other portion, being also frequently extremely dense, crackling under the scalpel like cartilage, and strewn with small deposits of a reddish chalky or cretaceous matter. Hasse only found the black pigment wanting in the rare case of repair through calcareous deposit in young subjects. In elder persons it is so constant and so considerable, that a doubt might be entertained whether it be the cause of or the sequel to the cure of phthisis.

Dr. Carswell thus describes the curative tendency of tubercles in the lungs, which, although it is in some measure a *resumé* of the preceding, contains some points especially indicative of this eminent pathologist's views, which I accordingly introduce:—

Appearances indicating the removal of the aqueous and animal matter, and the *condensation of the earthy salts,* are frequently observed in the lungs of persons whose history leaves no doubt as to their having at some period of their lives been affected with tubercular phthisis.

The tubercular matter, whether contained in a bronchial tube, the air cells, or areolar tissue of the lungs, assumes a dry, putty-looking, chalky character; if this is found in an excavation, the surrounding pulmonary substance is generally dark-coloured; and if the excavation exists in the course of large bronchial tubes, those situated between the excavation and the periphery of the lungs are obliterated; whilst those in the opposite direction terminate all in a short extremity near the excavation, or are continuous with the lining membrane or accidental tissue which encloses the altered tubercular matter.

This accidental tissue is formed by the effusion of coagulable lymph on the surface of the excavation or in the substance of the contiguous pulmonary tissue; it has at first, and so long as a ready exit is afforded to its secretion, the character of simple

mucous tissue; but at a later period, and especially where the latter condition is wanting, it becomes gradually and successively converted into serous, fibrous, fibro-cartilaginous and cartilaginous tissue. The cartilaginous and osseous tissues are rare, more particularly the latter; it more frequently retains the fibrous character, and possesses the property of contracting so as to diminish the bulk of the excavation, and along with it the pulmonary tissue with which it is connected; the diminution of bulk gives rise to a puckering of the lung which is best seen when the pleura is forced to follow the retrocession of the pulmonary substance before and around what is called the cicatrix. There sometimes remains only a small, circular, oval, or even linear portion of fibrous or fibro-cartilaginous tissue, on a part of the lung, where, from the extreme puckering around it, there must have formerly existed an excavation of considerable extent.

THE PATHOLOGICAL ANATOMY OF THE LUNGS IN TUBERCULOUS CHILDREN.

The pathology of the lungs in children differs in some important particulars from the foregoing; in other respects there is a very close correspondence. The whole subject is most fully treated of in the work by MM. Rilliett and Barthez which I have so frequently quoted. The following is chiefly a condensed view of their observations:—

(*a*) *Tubercles in the Lungs in Children.*—In 312 tuberculous subjects from 1 to 15 years of age, examined by MM. Rilliett and Barthez, 265 had tubercles in the lungs, and in 47 cases these organs were perfectly free, that is to say, one in about six or seven cases. In the 265 cases with tubercular lungs, there were found:—

Grey granulations	94
„ infiltration	42
Tubercular dust	15
Yellow granulations	68
Miliary tubercles	164
Yellow infiltration	88
Softened tubercle	39
Caverns	77
Chronic pneumonia	19

The lungs of tuberculous children remain healthy more frequently between the ages of 3 and 5½ years than at any other period; they are more prone to tubercular disease between 1 and 2½ years, still more between 6 and 10 years; and again, less so

between 10 and 15 years. Up to six years the right lung is a little more frequently diseased than the left; in much more than half the cases both lungs are affected, but this happens the least frequently in the youngest; when one lung only is affected in the youngest children it is most frequently the right, and in those of more advanced age the left.

(*b*) *Grey granulations* are sometimes observed on the surface of lungs at the first sight apparently healthy; they give a granular sensation to the finger, and on close inspection are raised above the surface; at the same time a very fine, soft, false membrane may be observed in the pleura, limited to the extent of the granulations, and easily peeled off; the smooth polished pleura having separated the false membrane from the tubercle. The friction of the rough surface of the lung in this case appears to have excited the limited exudative inflammation. They occur with other forms of tubercle, are generally very numerous, pervade one lung as frequently as the other, and very often both; are generally more frequent in the upper than in the lower lobes, but sometimes equally disseminated; occur exclusively in the upper, occasionally, and much more rarely in the inferior lobes. While in the adult Louis found grey granulations alone in five cases only out of 123, MM. Rilliett and Barthez state that out of 265 cases of pulmonary tubercle in the child, in 11 grey granulations occurred in both lungs, without any other form of tubercle; and taking each lung separately, in 10 cases they occurred alone in the right lung, and in 15 cases alone in the left. In 81 cases of children, Dr. West found 13 instances of the presence of grey granulations alone.* It is extremely rare to find one lung containing grey granulation only, while the other contains no kind of tubercles.

(*c*) *Grey infiltration*.—This exists in the lungs of children in more or less voluminous masses, or in bands or zones, rarely invading an entire lobe, unless it be the middle lobe. The larger bronchial tubes are inflamed, their mucous membrane being red, thick, softened, often ecchymosed and sometimes dilated into pouches (vacuoles) so as to resemble a collection of caverns in the midst of the grey matter. This bronchitis is so connected with the grey infiltration that it occurs when the bronchi of the surrounding lung are perfectly sound. It becomes more frequent as children advance in years; it generally occupies the superior lobe, is less frequent in

* On the Diseases of Infancy. 1852. p. 310.

the middle, and still less in the inferior lobe, and it exists exclusively in the superior or middle lobe rather than the inferior. In one case only it was the sole tubercular lesion in the lungs.

(*d*) *Yellow granulations.*—With a few exceptions they obey the same laws of distribution as grey granulations; they are rather less frequent in both lungs at once, but they are found almost as frequently in the inferior as in the superior lobe, and they have a greater tendency to invade the inferior lobe to the exclusion of the others. In one case only, both lungs contained yellow granulation alone; but it is somewhat more common to see this in one lung—six times they occurred alone in the right lung and eight times in the left. Lastly, once in the left lung and three times in the right, one lung contained yellow granulations, the opposite lung not containing any other variety of tubercle.

(*e*) *Yellow infiltration.*—This is much more frequent in children than in adults. The crumpling of the exterior of the lung, a circumstance observed when it contains miliary tubercle, is not produced by this form. The infiltration occurs, on the contrary, in the form of yellow patches, which extend in surface more than depth. It varies in size and depth, and is usually surrounded with miliary tubercles and yellow granulations, which tend to unite with it. Sometimes this variety has nothing special but its position and its tendency to unite with tubercles in the bronchial glands. At other times the whole of a lobe is filled with it, being solid, but the lobules continue defined; as if they had been carnified. Sometimes the yellow infiltration is not seen at the surface but invades the whole interior of a lobe. Sometimes it occurs at the extremity of a dilated bronchus, and on cutting through the bronchus it appears to fill the tube, and all trace of the tube being lost within the tubercular mass. Around the interior of the bronchial tubes yellow patches are also observed, which are neither more nor less than tubercle seen through the transparent lining membrane; the tubercular matter in this case is more or less abundant, and when in great quantity it terminates by invading the whole exterior of the bronchus, the tube being almost always dilated. At other times these patches are nearer the mucous surface, and scarcely covered with a fine membrane, but almost denuded, in the interior of the air tube; and, again, they may really project, producing a small perforation, around which the mucous membrane is pale and attenuated. The bronchi thus affected sometimes terminate in a tubercular mass, con-

tinuous with that which appears within it, so that in following them they are gradually lost sight of without being able to determine where they terminate. The bronchial tubes appear in some cases to be worn away by the progression of the tubercular matter from without inwards, previous to softening, and before any signs of inflammatory action. These masses subsequently become intra-bronchial, and may soften and give rise to tubercular cavities.

Yellow infiltration occurs nearly as frequently in one lung as the other; it is most frequent in the superior lobe, and more frequently limited to one portion of lung than the other varieties. It occurred in no case exclusively in both lungs; in six cases the right and in eight the left lung contained no other variety of tubercle; in six cases the right and in five cases the left lung contained yellow infiltration exclusively, the opposite lung containing no tubercles of any kind. It occurs in about a third of the children in whom the lungs are tuberculous, and is rather more frequent from 1 to 2½ years of age than at any other period; and in infants of this age it occurs in the right lung much more frequently than the left, while at all other ages the left lung is most frequently affected by it. It was generally accompanied with cavities, miliary tubercles, or miliary granulations.

(*f*) *Miliary Tubercles*—are those which most frequently invade the lungs of children; they are rather more frequent in the right lung than in the left; frequently exist at the same time in both; in the greater number of cases they occupy both the superior and inferior lobes; they occur in considerable quantity, especially in the superior lobe; often, however, their number is limited, and in this case the inferior lobe is as frequently affected as the superior; occasionally they are equally disseminated over all the lobes; of the total number of children with miliary tubercle, nearly a third have this kind alone. Louis found miliary tubercles alone, in the adult, in only two out of 123 cases of phthisis; whereas, in the 312 cases of children, MM. Rilliett and Barthez found 44; in 12 cases there were miliary tubercle alone in both lungs; in 32 cases in the right lung alone; in 28 cases in the left alone; in 17 cases the right lung, and in 15 the left, contained miliary tubercles only, there being no kind of tubercle whatever in the opposite lung. Dr. West found 18 instances of miliary tubercles alone in 81 cases. (Lib. cit., p. 310.) Groups of grey granulation, yellow granulation and miliary tubercle, occur in the same lung.

(*g*) *Tubercular Dust.*—Grey infiltration and the deposits of acute and chronic pneumonia are the habitual seat of this form of tubercle; it rarely occupies a large space, yet a considerable portion of a lobe has been seen pervaded by it, together with masses of tubercle. It was met with more frequently in the right than the left lung, rarely in both, and generally occurred in the superior lobes. In two cases the lungs contained no other description of tubercle. Rilliett and Barthez give a case in which the "dust" consisted of both yellow and semi-transparent grains developed in the midst of a tissue scarcely congested.

(*h*) *Softening.*—In children as in adults, tubercles soften in the lungs more frequently than in any other organ, but this softening is observed more frequently from 11 to 15 years of age than previously; least frequently from 3 to 5 years; and rather more frequently from 1 to 2½ years; more frequently in the right than the left lung, and rarely in both; they soften also somewhat more frequently in the superior than the inferior lobes, and rarely without involving several lobes.

(*i*) *Cavities.*—These are less frequent, but their structure does not essentially differ in children and adults. The bands by which they are sometimes traversed more frequently contain permeable vessels than in the adult; on making a section of a band, a drop of blood very frequently exudes, and the orifice of a canal presents itself. Rilliett and Barthez never found these vessels ruptured. The walls are covered with a yellow, soft, thin, false membrane; not continuous at all points; easily peeled off; with a subjacent, red, sometimes ecchymosed, soft, mammillated as it were, fungoid, true pyogenic membrane of variable thickness; and exterior to this there is grey infiltration, or the pulmonary tissue is hepatized, and very rarely permeable to the air. The bronchial tubes sometimes project into the cavity, and at others no line of demarcation can be observed between the inflamed mucous membrane of the bronchi and the red lining membrane of the cavity; they are generally destroyed in their entire calibre, and cut off perpendicularly to their axis; but occasionally they are open at their sides, and a part only of their diameter destroyed as if by lateral ulceration, just as the bronchi open into cavities in the bronchial glands. Sometimes a whole lobe, and even a portion of the neighbouring lobes, is converted into a vast yellow infiltration, from which the bronchi, vessels, and parenchyma disappear; the mass softens at

the centre, and is in part evacuated through large ulcerated bronchi; leaving an anfractuous cavity lined over nearly all its surface by large semi-softened tubercular masses, on removing which, sometimes the red lining membrane, raised by vessels either empty or full of clots presents itself, or the whole, including even the pleura, has disappeared; the softening here manifestly commences in the centre, and cannot depend on inflammation of the pulmonary parynchyma, since at the periphery the tubercle is still crude.

When a single cavity occurs, it is in general of considerable size; when several are met with, they are of various forms. Sometimes a vast cavity is surrounded by several small ones communicating with it by one or more openings; at another time there is a multitude of small cavities about the same size, from a few millimeters to a centimetre in diameter. MM. Rilliett and Barthez have designated these "*vacuoles;*" they are irregular, anfractuous, covered with false membranes, or smooth and polished, as if lined with a serous membrane, and often filled with tubercle, all circumstances which distinguish them from mere dilated bronchi.

In children, as in adults, pulmonary caverns may be superficial or deep seated; in the latter case they are surrounded by morbid tissue, and have no tendency to perforate the pleura; in the former case their parietes are thin and flaccid, and if the corresponding pleura costalis does not adhere, perforation may take place readily.

Rilliett and Barthez describe a case (p. 234) which shews that the existence of solid adhesion is not always necessary to prevent the formation of pneumothorax; it would appear that where there is slow and gradual destruction of the pleura, provided there is nothing to prevent the lungs following the motion of the ribs, this event may not happen.

Cavities are more frequent in very young infants, owing to the frequency of yellow infiltration at this age, and the facility with which large masses of it soften at the centre; and at this age the cavities are also often of enormous size, and are sometimes almost wholly surrounded by tubercular matter; and this kind of cavity should be distinguished from those which result both from the central softening and suppuration of the surrounding tissues. In children of advanced age, caverns are much more frequent in the superior than in the inferior lobes, but in very young infants they are relatively more frequent in the inferior and middle lobes

than in the superior; in the former, they follow the same laws of organization and position as in adults; in the latter they follow the same disposition as the yellow infiltration.

In very rare cases, where the deposit of tubercle is limited, and where one cavity only exists, this becoming a suppurating wound, after the elimination of the tubercle, may cicatrize and heal. This is less frequent, perhaps, in infancy than at any other age, but its occasional occurrence is not to be doubted; the cicatrices present themselves generally, but not always, on the exterior of the lung as in the adult. Cretaceous concretions also occur as evidence of the cure of the disease, and indicate that the tubercular matter, not having been eliminated entire, has been in part absorbed. Most frequently miliary tubercle and grey granulations, evidently of more recent formation than the cicatrix, prove that the local affection was cured, the disease of the blood not having been eradicated.

MM. Rilliett and Barthez infer from rarely meeting with cicatrices in the youngest infants, and from their occurrence being more frequent in the left side than the right, that caverns which result from the softening of large tubercular masses are not curable, and that those only can cicatrize which approach in character to the tubercular excavations of the adult. Most of the children in whom they found cretaceous tubercles were from 6 to 10 years old; they were nearly as frequent in the right lung as the left, and more frequent in the superior than in the inferior lobe. There were eight cases in which no other kind of tubercle occurred, either in the one lung or more rarely in both lungs.

(*j*) *The results of Bronchitis.*—These frequently accompany pulmonary tuberculization in infants: they depend either upon the deposit of tubercle, or the pneumonia which accompanies it; when upon the former they differ according to the varieties of tubercle or state of tuberculization, whether grey infiltration or cavities. When there are cavities, the portions of the bronchi opening into them are bright red or purple, increasing in intensity as the tubes approach the cavity, and sometimes accompanied with thickening of their coats, and frequently with softening; this bronchitis is generally of small extent, and seated in the larger bronchi. When the tuberculization is considerable, and consists of isolated crude tubercles, the effects of bronchitis sometimes extend to the first ramifications, and may continue to the summit of the lung, so as to

furnish stethoscopic signs, which might be mistaken for the softening of tubercle. Sometimes there are simple erosions or superficial ulcerations of the mucous membranes, rarely perforating it, which have to be distinguished from the ulcerations which proceed from tuberculosis glandulæ, the course of which is from without inwards. These ulcerations are always accompanied with violent inflammation, proceeding even to complete softening, and the bronchial tubes at the same time always contain a considerable quantity of purulent mucus. This kind of ulceration is sometimes met with where there are no cavities, in infants with only miliary tubercles and grey granulation.

(*k*) *The results of Chronic Pneumonia*—which Rilliett and Barthez regard as the transition stage between acute pneumonia and grey infiltration, are met with only in tuberculosis, and constantly with pulmonary tubercles; are in general very limited; exist rarely in both lungs at once; and much more frequently in the superior and middle than in the inferior lobes. All the cases in which it occurred had at the same time, and in the same lung, yellow or semitransparent grey granulations.

(*l*) *The results of Acute Pneumonia.*—These are the morbid appearances which, as in the adult, most frequently accompany tubercles in infants. The anatomical characters are absolutely the same as those which characterize simple pneumonia. Lobular pneumonia and all its varieties, pneumonia of a whole lobe and carnification occur. Once only vesicular pneumonia was observed. Some modifications result from age and the character of the tubercle: thus, where there are distinct miliary tubercles, nodules of lobular pneumonia may be observed here and there in the midst of the tubercles, and sometimes surrounding them; so that on cutting a portion of the inflamed lung a crude tubercle will be found in its centre, while at its side an isolated tubercle or a lobule simply inflamed may be observed.

The pneumonia of tubercular lungs in infants as in adults depends on various causes. 1. It is produced by the irritation of the tubercle which is then surrounded by it, and a hepatized tissue is found mixed with tubercles; this may be lobar or lobular, but much more frequently the latter. 2. A lung being very tubercular the pneumonia may be seated in a part containing but few tubercles; that is to say, at the base; this is generally lobar, and cannot be attributed to the direct irritation of the foreign body, but probably

to the acquired susceptibility of the part of the lung in which the function of hæmatosis is almost exclusively carried on. 3. The lung being slightly tubercular while other organs are considerably affected, a pneumonia may occur which is not under the influence of the tubercle; a secondary inflammation, analogous to that which complicates chronic enteritis having in general the character of a cachectic inflammation. 4. Tubercles being rare in all the organs pneumonia may recognize a cause quite independent of them, as measles, hooping cough, and similar diseases.

In pneumonia depending upon tubercle, the lobular form is more frequent before ten years of age than after, it occurs more frequently in the right lung than the left, and very often in both: of 67 cases—the right lung in 11 and the left in 6 instances, was alone affected; and both lungs in 52 instances: a result which differs from simple lobular pneumonia, and shews that the presence of tubercle is the cause of the local inflammation.

Thus a great proportion of tuberculous children have tubercle and pneumonia combined, either in both lungs or in one only; a smaller number have tubercles without pneumonia, in one or the other lung, or both; and in a still smaller number, pneumonia without tubercles. In 312 tuberculous children, 11 only had neither tubercles nor pneumonia, the lungs being perfectly healthy.

C.—THE HEART.

We have no very satisfactory observations as to the condition of the heart in tuberculosis generally, but a considerable number relating to its state in phthisis pulmonalis in the adult, and great discrepancy among them. In 112 patients cut off by phthisis, Louis found an obvious enlargement in three only. The organ was below the natural standard, being scarcely one half or two thirds its usual size, in the greater number of cases, and in a majority of those which had followed a chronic course. It was flaccid and soft in about a fifth of the cases, but sometimes firmer than natural. Its parietes, particularly those of the left ventricle, were sometimes thickened, and its cavities diminished, but this resulted from retraction, and not hypertrophy. Louis found the different states of the heart very much the same in other chronic diseases.

Dr. Boyd found the average weight in 141 cases, male and female, somewhat increased.

Hasse's experience shews that when tuberculosis pulmonalis has

been of long duration, dilatation and hypertrophy of the heart are by no means infrequent. The parenchymatous disease of the lung impedes the pulmonary circulation, and the result is in some cases positive dilatation of the right ventricle, or of both auricle and ventricle, and occasionally dilatation or hypertrophy of these with dilatation of the left cavities. These effects are said to be more marked when a curative tendency is exhibited, as by the existence of calcareous concretions, and emphysema. At the same time, in Rokitanski's dissections, extending to 12,000 cases of all diseases, very marked hypertrophy and dilatation of the heart were scarcely ever concurrent with tubercular disease.

Violet discoloration of the endocardium, of various degrees of intensity, is also observed in phthisis; the substance of the heart being pale and flaccid; the pericardium at the same time containing a thin, dingy, red fluid. The appearance is met with in other diseases attended, in their later stages, with a high degree of disorganization of the blood; as in typhoid fevers, pyohæmia, phlebitis, puerperal fever and others.

Both sides of the heart are for the most part filled with black coagulated blood, and when inflammatory action in the respiratory organs has prevailed during the close of life, fibrinous clots, more or less extensive, are said to be never wanting.

1. *Fatty Heart.*—In fatal cases of the pulmonary form of tuberculosis, the heart is generally externally devoid of fat; an exception however is made by some pathologists of old persons in whom the tuberculous affection has been of long standing, and complicated with certain morbid states of the liver. It has also been observed that the absorption of fat is sometimes incomplete, its former seat being still indicated by the presence of a reddish yellow jelly.

But the heart is occasionally fatty. M. Bizot recorded four cases of a fatty condition coinciding with a fatty liver, all occurring in females; the inferior part of the anterior parietes of the left ventricle was fatty, the fleshy fibres being pale, small, and surrounded with fat. This condition was also found in non-phthisical females, but there was a greater quantity of fat in phthisis, and the tendency was greater. Hasse also found fatty heart in seven cases, coinciding with a granular or fatty liver; with deposition of blackened masses — "cicatrized tubercular cavities," and with actual tubercles in the lungs; the subcutaneous areolar tissue being nearly devoid of fat in four of the cases.

In phthisical subjects dying suddenly of syncope, the muscular substance of the heart has been found altered by the fatty condition which occurs in diseases of depraved nutrition.*

2. *Tuberculous or Scrofulous Inflammation of the Heart*—and suppuration, have occurred occasionally. Wiseman records a case in which a scrofulous swelling weighing two ounces was attached to the apex.

3. *Tubercles in the Heart.*—The occurrence of tubercles in the pericardium has been stated (p. 200). In addition to the illustrations already given, Dr. Peacock mentions a case in which a solitary mass of softish yellow tubercular matter was found beneath the pericardium covering the right ventricle; and also another—which is important, inasmuch as the lungs did not contain tubercle—in which numerous masses of tubercle, varying from the size of a pin's head to a split pea, were seated, apparently, in the subserous areolar tissue, or on the surface of the pericardium, in a female, aged 28 years; the bronchial glands were extensivly tubercular. †

Tubercle is described as having been sometimes deposited in the heart itself, but in all these cases there is some question as to the tissue in which it is seated. Laennec saw three or four cases. Andral never found them there but when they existed at the same time in other organs. Lloyd met with a case of tubercle deposited in the heart of a phthisical rabbit; there were three masses of tubercle as large as a pea in the substance of the left ventricle; the lungs and kidneys were studded with tubercles, and there were also hydatids between the scapula and trunk, and among the flexor muscles of the thigh.‡ Louis quotes a case § in which a tubercular tumour was found in the substance of the walls of the heart, with a few miliary tubercles in the lungs, in an individual aged 61.

A tubercular mass nearly an inch thick was found by Dr. Townsend deposited between the outer and inner membrane of the parietes of the left auricle, the bronchial glands being much enlarged and filled with tubercular matter, the lungs containing

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* Dr. Quain, Med. Chir. Transac., vol. xxxiii, p. 176. Lancet, 1843-44, vol. i, p. 835.

† On the Co-existence of Granular Disease of the Kidneys with Pulmonary Consumption; The Monthly Journal of Medical Science, August, 1845—Note.

‡ Lib. cit., p. 301. § Arch. Générales, Jan. 1833.

only a few miliary tubercles. Its effects in causing dilatation of the pulmonary veins has been described (Section V. B., p. 223).

Rilliett and Barthez quote a case, referred to under the head "*pericardium*," in which a spurious hypertrophy of the heart was the consequence of the development of tubercles in the midst of the fleshy fibres. The authors avow that tuberculization of the tissue of the heart is infinitely rare, although they quote Dr. Couture to the effect that it has been found in the valves and the muscular fibres. At all events it has been known to be primarily developed in the muscular interstices. In all the cases met with by them there was extensive general tuberculization.

A case is recorded by Dr. Kerst of a young man, æt 21, who died much emaciated, but without symptoms which had excited any suspicion of heart disease. Tubercles were found in the upper part of the left lung and in the mediastinum; the heart was of its usual size, but adherent to the parietal pericardium, between the two surfaces of which were large masses of tubercle; two large tubercles in a state of softening existed in the muscular structure, and there was yellow softening of the outer wall of the left ventricle.*

D.—THE STOMACH.

The morbid anatomy of the mucous and serous tunics of the stomach has already been described.

The stomach was found by Louis increased in size in more than two-thirds of the cases of phthisis; in extreme cases of tuberculosis, and more particularly after death from phthisis, it is almost always enlarged, being sometimes double or treble its natural volume, and in about a fifth of the cases it is attenuated. It exhibits also a remarkable displacement in the direction of the meso-gastric region, assuming a more vertical position than natural, so that its great curvature, instead of forming its base, inclines to the left, and the organ sometimes reaches the level of the crest of the ileum. Louis says the liver in all these cases is enlarged and carried downwards, and that there is always a relation between the state of the stomach and the liver. This deformity and displacement occurred in a decided form in about one-tenth of the cases of phthisis, and is seldom observed in persons dying of other diseases. As respects its causes, Louis attributes much to the repeated concussion from habitual cough; but it cannot be referred

* Brit. and For. Med. Rev., Oct., 1843, p. 385.

to this alone. Consumptive individuals have frequently good appetites, nevertheless their digestion is frequently imperfect, and the walls of the stomach are greatly attenuated; it becomes a question to what extent the mechanical effects of the weight of the food, and the distension produced by the gases extricated, may be concerned in the production of this remarkable condition.

E.—THE LIVER.

It may be stated, as a general rule in tuberculosis, that in all its varieties, and at all ages, this organ is liable to be hypertrophied, or at all events increased in bulk and weight. In tuberculous infants, immediately after birth, the natural hypertrophy does not diminish as in the healthy constitution, and the organ does not retire behind the ribs as usual. This fact has been recited in the description of the tuberculous predisposition, and it is there stated that Dr. Parolá has lately attached to it the very highest importance. After death from phthisis, Drs. Clendenning and Boyd found it, in common with the other viscera, generally heavier than natural. According to the latter its average increase of weight above the natural standard, in a large number of males, was about five ounces and a half, and in a large number of females about seven ounces. Its volume is for the most part augmented. Clendenning also found it denser than natural, but this is not always the case. For the most part it is pallid, or of rather a yellowish hue; its blood-vessels are loaded; in some instances it assumes the contrary character; but more frequently than either of these it is fatty.

1. *The Fatty Liver.*—This is met with occasionally in those who die of scrofula without deposit of tubercle, but more frequently in those who die of tuberculosis pulmonalis: it was found by Andral and Louis in one-third of the cases of the latter disease. Out of 49 cases of fatty liver met with by Louis 47 were cases of phthisis. It is, however, by no means constant, and we shall presently see that it is a comparatively rare occurrence in children.

In 98 cases examined by Dr. Reid and Dr. Peacock in this country, the liver was found fatty in 13 only. The latter also found in 8 cases of fatty degeneration of the liver 5 of granular disease of the kidney, and he observes, that in this country it would appear that the affection of the kidney exerts an influence over the development of the fatty state of the liver. (Lib. cit.)

The fatty liver has the following characteristics:—The organ is enlarged, chiefly in a lateral direction; its edges flattened and swollen; the peritoneal coat smooth, shining, transparent and tense; its substance soft and pitting; its colour, internally and externally, uniformly yellowish-red or light yellow, resembling that of autumnal foliage; it is pale and exsanguine, and contains a large amount of fat, as shewn by a greasy deposit when cut with a dry, warm blade, and when pressed after being submitted to an elevated temperature; its specific gravity is lower than natural.

The following observations by Mr. Bowman on the minute anatomy of this fatty condition are most interesting and important.* The enlargement of the organ is always in a degree proportioned, *cæteris paribus*, to the quantity of fat it contains. The fat is never collected into masses but is equally diffused throughout the whole viscus; it occasions no obstruction to the portal circulation, as is clear from its being always unattended with ascites, and other symptoms referrible to such an obstruction. The seat of the accumulation of fat is in the secreting portion of the bile-ducts, in the nucleated cells, which, in its physiological state, always contain a few oil-globules. In the fatty liver, instead of containing a few minute scattered globules, these nucleated particles are gorged with large masses of oil, which greatly augments their bulk, and more or less obscures their nuclei. The particles thus containing oil lie in the interstices of the capillary plexus, and enlarge slowly and equally, so as to exert no injurious pressure on the vessels, and thus is explained the bulk, the colour, and the freedom of the circulation in the fatty liver. The fat is an increase of the normal constituents, thus differing from fatty degeneration when the fat is deposited in tissues from which it is normally absent, and it shows clearly an increased activity in the secreting function of the liver for a considerable period before death.

It was remarked by Laennec that the fatty matter in the liver differs in its nature from ordinary fat:—"Sometimes it resembles fat, but at others, from its appearance and consistence, it appears to be analogous to those fatty bodies confounded together under the general name of *adipocere*."

A fatty liver, so light that it swam in water, was analysed by M. F. Boudet. The following formula represents its chemical composition compared with that of a perfectly sound liver:—

* Condensed from the Microscopical Journal, 1841, p. 129.

Fatty Liver.		*Healthy Liver.*	
Fat formed of oleine, and margarine, slightly acid	30·20	Saponifiable fat	1.60
Cholesterine	1.33	Cholesterine	.17
Dry animal matter	13.32	Ext. matters soluble in æther	.84
Water	55.15	Dry animal matter	21.00
		Water	76.39
	100.00		100.00

The diseased liver contained eighteen times more saponifiable fatty matter and eight times more cholesterine than the healthy liver, and the animal matter was reduced nearly to one-half its normal proportion.

Thus, the fatty liver resembles tubercle in containing a large proportion of hydro-carbonaceous elements, and many pathologists consider that this bears a relation to the diminished function of the lung and the diminished oxygenation of the combustible materials received into the blood. The fatty state of this and sometimes of other organs contrasts remarkably with the complete disappearance of fat from the external parts. An excess of fat in relation to the amount of respiration being received into the blood, it appears to be deposited in the parenchymatous part of these organs. Andral adopts a theoretical view which is very generally quoted —that the fatty liver of tuberculosis occurs when the blood is no longer completely elaborated, and when the pulmonary exhalation cannot be accomplished in the natural state; he conjectures that a sufficient quantity of hydrogen not being expelled from the lungs in the form of aqueous vapour, it is separated in excess in the pulmonary parenchyma in the form of fatty matter—pulmonary melanosis depending upon a defect of elimination of carbon by these organs.—(Path. Anat., vol. ii, p. 595.)

The fatty liver allies itself with tubercular affections of every kind; with tubercle of the lungs, intestinal mucous membrane, bronchial glands, serous membranes, &c.;—it has been regarded as essentially connected with the disease of the blood, but it certainly does not occur in an appreciable form in every case of fatal tuberculosis, and it is met with in other diseases.

The circumstance which militates most against the fatty liver being related to tuberculosis in that essential connection which some pathologists teach, is that tuberculous children are comparatively exempt from it. In 312 fatal cases Rilliett and Barthez found it in only 23 instances, that is, once in 13 times. It is also by

no means limited in children to tuberculosis, nor even much more frequent than in other diseases, in variola, rubeola, scarlatina, and measles, especially; in 211 non-tubercular children they found it 14 times, that is, once in 15 subjects. It was much more frequently fatty in very young infants not at all or very slightly tuberculous, than in those of more advanced age with a high degree of tuberculization. Females were more subject to it than males. In all the cases they found either inflammation or ulceration in the intestines; and, in some of the most intense cases, the intestines were extensively ulcerated. These pathologists observe, that when the affection is beginning in children a portion of the organ retains its natural red colour, but this tint gradually disappears, and the general characteristics of the fatty state are then progressive.—(Lib. cit., vol. iii, p. 454.)

It appears to be formed rapidly in some cases of tuberculosis pulmonalis, as it has been observed when the disease has terminated fatally in fifty days. Fatty livers very rarely contain tubercle, and looking at this affection in its most extensive bearings, the quantity of fat deposited in this organ appears to have no direct relation to the quantity of tubercle deposited in the tissues.

2. *Tubercle in the Liver.*—Wiseman, and subsequently Dr. Baillie, described "scrofulous tubercles" of the liver, spread through the whole substance of the organ, and sometimes converted into scrofulous pus.

The deposit of tubercle in the liver is a very rare occurrence in adults. It has been met with frequently in the lower animals. Jenner, Baron, and subsequently Carswell, succeeded in producing it in the livers of rabbits, and the latter followed its complete removal by absorption and excretion. When the cure was accomplished by the latter process—the most frequent case—no trace of the disease remained; when by the former he frequently found the surface of the organ marked by irregular furrows or depressions, apparently produced by atrophy of the substance around the seat of the tubercular deposit. Although doubts already referred to have been thrown upon the artificial production of tubercle in other experiments, I cannot think the pathologists here quoted could allow themselves to be deceived.

Rokitanski states, that tubercle rarely occurs in this organ, as a primary affection. It is generally met with in advanced tuberculosis. It occurs as semi-transparent, greyish, miliary granulations,

the product of acute tuberculosis; or as yellow, cheesy, adipose deposit, sometimes larger than pulmonary tubercle, but less disseminated. It is deposited in the parenchymatous areolar tissue, and especially that pertaining to the biliary capillaries, and frequently surrounds a minute gall-duct, and thus presents a central canal which gives rise to a biliary discoloration of the nucleus. Carswell, however, represents as the seat of tubercle in the liver of the rabbit, the surface under the peritoneal coat, it being lodged in the extremities of the gall-ducts, which were dilated into the shape of pyriform sacs, the tubercular matter being of the colour and consistence of cream. It is not limited to any particular section of the viscus. According to Rokitanski it rarely undergoes softening, and scarcely ever cretification, the constitutional disease generally proving fatal before these changes can take place; besides which, the difference in the structure and functions of the liver explain why suppuration does not so generally follow tubercle deposited in this organ as in the lungs and other parts. Still, occasionally, "from the very violence of the constitutional affection," softening occurs, and a vomica is formed.

An hepatic vomica must be distinguished from dilatation of the gall-ducts which occurs frequently with it; these consist in small cavities the size of a mustard-seed or pea, with flaccid parietes, filled with viscid, muco-bilious, dirty green matter, scattered through the liver. They are at various distances from the tubercles, and the latter are occasionally found near these cavities. The relation of these cavities to tuberculosis is not known. These pathological appearances in the liver altogether indicate a high degree of tuberculosis, and generally occur in connection with tubercular deposit of various other organs.

3. *Tubercle in the Liver in Children.*—The liver is very frequently the seat of grey granulations and miliary tubercles in children.

Grey granulation is found on the surface beneath the serous membrane, penetrating the substance of the organ, or on the external surface and without the peritoneum, and sometimes on the internal surface of this membrane; the granulations are generally smaller and of a lighter colour than in the lungs. They are sometimes diffused in an infinite number throughout the organ, resembling those which occur in acute tuberculization of the lungs.

Miliary tubercles are as common as grey granulation, but occur

in smaller quantity; they are generally seated within the substance of the organ, are isolated, and rarely larger than a pea;—occasionally they are found on the surface. MM. Rilliett and Barthez once saw the peritoneum perforated, and the perforation covered with a false membrane. M. Tonnelé found the liver of a child reduced to the size of the hand; its surface crumpled; its coat fibro-cartilaginous; its tissue of a yellowish colour, and very hard; it contained four or five large tubercles, three of which were hard, and to a certain extent, cretaceous; here and there were observed a considerable number of whitish cellular bands and fibrous cords resulting from the obliteration of the vessels; the gall-bladder was reduced in volume to the size of an almond, and contained almost solid bile.—(Lib. cit. 451.)

These authors further observe, that tubercle in the liver is frequently coloured yellow or greenish-yellow; they cannot affirm that miliary tubercles in this organ, in children, are susceptible of softening. They have found the biliary cysts, containing bile in their centres, occurring only in tuberculous subjects, which they also suspect may result from softened tubercle, placed around the hepatic ducts, these being destroyed as the bronchial tubes are in the lungs, with this difference—the hepatic ducts are contracted, while the bronchial tubes are dilated. They describe the complete isolation of portions of the hepatic duct by the morbid deposit.

In 312 tuberculous children 71 cases of tubercle in the liver were found:—

Grey granulation	42 times.
Miliary tubercle	37 „
Yellow granulation	4 „
Biliary cysts	14 „

4. *The Biliary Ducts, the Gall-bladder, and the Bile.*—Carswell once found a great quantity of tubercular matter in the biliary ducts of a cow; some of them, which in their natural state do not exceed the size of a crow's quill, were dilated by the accumulation of tubercle, so that they nearly equalled in diameter the human gall-bladder; the omentum, the lungs and the pleura were also tuberculous. Tubercular deposit in the biliary ducts is, however, very rare in man. They are occasionally compressed by masses of tubercle in the neighbourhood, so as to produce jaundice.

The post mortem characters of the bile, although a subject of great and increasing interest, have been very cursorily noticed.

MM. Rilliett and Barthez found this fluid very variable in children, rarely presenting the same appearances in two instances. In the adult the gall-bladder has been found filled with bile, and also with a tenaceous white fluid.

F.—THE PANCREAS AND SALIVARY GLANDS.

Although disorganization of the pancreas is a rare occurrence in tuberculosis, there is reason to think it has been sometimes overlooked in the autopsy. Wiseman refers to a case of Dr. Needham's of a strumous abscess in this organ which contained a pint of matter; but he remarks, that the pancreas is more frequently surrounded with strumæ, itself remaining untouched.* Portal found the pancreas indurated, particularly in the neighbourhood of the duodenum.† Lloyd met with an instance of an abscess of the pancreas containing nearly two ounces of matter, very similar to that which scrofulous abscesses contain.‡ Although Rokitanski affirms that tubercle is never discovered in the pancreas nor in the salivary glands Wiseman described the salivary glands as being like the pancreas sometimes affected with scrofula, but more frequently compressed by neighbouring lymphatic glands enlarged by struma, themselves remaining sound. He makes this remark of the parotid and submaxillary glands, and also of the thymus gland.§ Lloyd describes "scrofulous abscesses" of the parotid and submaxillary glands.‖ Lombard found tubercle in the pancreas five times in 100 young tuberculous subjects. Harless gives two instances of tubercles in the pancreas (phthisie *pancréatique*); in one the organ was soft and contained tubercles of a cartilaginous hardness; and there are other records of isolated cases of tubercle in this organ.

G.—THE SPLEEN.

In tuberculous subjects the spleen is occasionally enlarged, but sometimes smaller than usual, and its texture more or less softened. Clendenning, however, found its absolute density increased in phthisis. It has occasionally been found fatty when the liver was not so.

1. *Tuberculous Inflammation of the Spleen.*—MM. Rilliett and Barthez describe this as occurring in children; the tissue of the organ is of a reddish-yellow colour to a greater or less extent; it is very

* Chir. Treat., 1692, p. 251. † Lib. cit., p. 16—30—108. ‡ Lib. cit., p. 251.
§ Lib. cit., p. 304. ‖ Idem., p. 57.

firm, neither pitting nor breaking, nor allowing the finger to penetrate on pressure; it appears as if the fibrous tissue of the parenchyma remained, and tubercular matter or concrete pus had been infiltrated.—(Lib. cit., p. 467.)

2. *Tubercle in the Spleen*—is common in the horse and other animals. M. Raynard found it more frequently in the spleen than in the lungs in monkeys. In the human subject it is comparatively rare in adults. Louis found it seven times in ninety adults—but it is much more common in children; it has never been found without appearing at the same time in other organs, and a tubercular spleen generally forms part of a complicated state of disease of the internal organs, and generally occurs in an advanced stage of tuberculous local disease.

Tubercles appear in the spleen either in the shape of numerous clustered or isolated grey transparent or opaque white granulations of the size of a pin's head or mustard-seed; or as crude yellow cheesy masses, varying from the size of a mustard-seed to that of a pea; indicating the more or less acute form of the disease. Their seat is the parenchyma. The organ appears swollen, according to the number and size of the morbid deposits, but they seldom pass beyond the stage of incipient softening; suppuration is infinitely less frequent than in the lungs, but there are instances of its occurrence.

3. *Tubercle in the Spleen in Children.*—In tuberculosis pulmonalis of young persons from the age of five to fifteen years, the complication with tuberculosis of the spleen is much more frequent than in adults; and in children, Rilliett and Barthez shew that it is one of the organs most frequently affected. In these young subjects the deposit occurs in nearly all its varieties. 1. *Grey granulation* on the surface or in the substance of the organ. When on the surface it is generally flattened, as on the surface of the liver; the peritoneal coat of the organ and the peritoneum itself being partially or generally adherent and free from any partial false membranes. 2. *Miliary tubercles*—remarkable for their abundance, so as to obscure the parenchyma entirely; they occur in all stages of crudity, but a true cavern was never met with. 3. *Amorphous masses*:—these are seldom larger than a nutmeg, and, as in the lungs and pleura, they sometimes embrace a portion of tissue or a vessel, and in the latter case they present a red sanguineous point in the centre. Of 312 tuberculous children the spleen was affected in 107. Boys,

75; girls, 32; and the younger the children the more liable they were to tuberculization of this organ.

These 107 cases presented :—

Grey granulation . . .	. 24 times.
Yellow „ . . .	. 9 „
Miliary tubercles . . .	. 87 „
Tubercles in masses . . .	. 9 „
„ softened . . .	. 2 „

They were :—

Very abundant in . . .	. 25 cases.
Rather less so „ . . .	. 25 „
Disseminated „ . . .	. 57 „

4. *Tubercles in the Blood of the Spleen.*—There is a very curious circumstance connected with the spleen in tuberculosis. Andral mentions the development of tubercular matter in the fibrine which the cells contain, but he thinks it highly probable that it is merely blood deprived of its colour and altered in its consistence, so as to become curdy and friable. Carswell represents the formation of tubercle in the blood contained in the cells of the spleen. I apprehend they both refer to the same appearance. The following is Dr. Carswell's description :—In one point of the organ the blood is coagulated, dark and firm; in another, it has lost its dark red colour, and resembles fibrine tinged with blood; in the latter state it has assumed a definite or circumscribed form, appearing either as small granular bodies, or as irregular masses of considerable size; lastly, the red fibrine disappears, and is replaced by a nearly colourless substance composed of pale fibrine and tubercular matter. In a single cell of the spleen the tubercular matter occupies the centre of the cell, and is surrounded by a globular layer of fibrine of considerable thickness, and if the latter becomes organized the tubercular matter is found encysted.—(Pl. iii, fig. 5, 6.)

Rokitanski has made the observation, that a small central cavity is sometimes found within tubercles of the spleen, and the tubercle is occasionally surrounded by a cyst or capsule of fibro-lardaceous texture, which demands special investigation for its elucidation.

Numerous *illustrations* of this particular localization of tubercle will be found in the works extant on pathological anatomy. In Book xxxi, pl. iv, fig. 3, Cruveilhier delineates tubercles at the root of the spleen of a phthisical subject 10 or 12 years' old, who died with tubercles in the lungs, the bronchial glands, and the ab-

dominal glands. Several glands at the root of the spleen are tubercular, the spleen is studded with irregular tubercles, its tissue is remarkable for its deep brown colour; several tubercles are in their incipient stage, and surrounded by indurated tissue. Fig. 4 represents the spleen of a phthisical child, aged four years; the child died of tuberculosis mesenterica; the liver was studded with a multitude of very small, miliary, perfectly transparent tubercles; the tubercles of the spleen are very numerous, white, and more advanced than those of the liver.

Glover mentions a case of tubercles in the spleen in an adult whose lungs were quite free.—(Lib. cit., p. 315.)

SECTION VIII.

THE PATHOLOGICAL ANATOMY OF THE URINARY ORGANS IN TUBERCULOSIS.

The morbid anatomy of the mucous membrane of the urinary organs in tuberculosis has already been described (p. 186), and can with difficulty be separated from that which follows.

A.—THE KIDNEYS.

The kidneys are not peculiarly liable to inflammatory disorganization as a primary affection in this disease, but there can be no doubt that tuberculous chronic nephritis of a suppurative tendency sometimes occurs, and tuberculous nephritis is frequently met with as a secondary affection, particularly in the adult. Albuminous nephritis with anasarca also occasionally complicates tuberculosis, both in the adult and in children. MM. Rilliett and Barthez found nephritis and other non-tuberculous affections of the kidneys rare in tuberculous children. The deposit of tubercle in the kidneys is a common occurrence; cases are recorded by Morgagni, Fleisch, Cruveilhier, Rilliett and Barthez, Carswell, Rokitanski, and others.

1. *Granular Disease of the Kidneys.—Bright's disease*—is said by some to be frequently met with in those who die of tuberculosis. It sometimes occurs when disease of the kidneys has not been expected, at other times when it has been diagnosed by albuminous urine and other symptoms. In 117 dissections of Bright's disease, collected by Dr. Peacock, (Lib. cit.) from cases recorded by Dr. Gregory, M. Rayer, and himself, in 26

cases there was extensive tuberculosis of the lungs, and a few tubercles deposited in 10 others. In some of those cases also in which the lungs were not diseased, there was tuberculous disease in other parts, as scrofulous ulcers, tuberculous peritonitis, caries of the bones, &c. On the other hand, Dr. Bright has stated, of 100 cases, that the coincidence of tuberculosis was rare, and Dr. Theophilus Thompson, of the Hospital for Consumption, confirms Dr. Bright's statement.* So that it is extremely doubtful whether the coincidence is only accidental or indicates any essential connection. Dr. Christison, M. Rayer, and Dr. Peacock regard tuberculosis—"the scrofulous diathesis" as a powerful predisposing cause of the kidney affection, and where the two coincide, the affection of the lungs as very rarely secondary to the granular disorganization of the kidney, but in by far the majority of the cases the deposit of tubercle in the lungs is primary. If so, granular disease of the kidney is a part of the morbid anatomy special to tuberculosis. Tuberculosis with granular disease occurs most frequently in early life, an additional evidence of a relation between the two—of 116 cases, where the age is given, 22 are stated to have been 25 years and under, nearly half of which presented extensive tubercular disease, while of the remaining 94 a fourth part only were affected with tubercle in a high degree. Granular disease of the kidney is said to be more frequent in phthisis than the deposit of tubercle in these organs. For the most part where this state of the kidneys is found the tubercle in the lungs has softened and formed caverns, and the effect on the tuberculosis appears to be very materially to add to its severity and to hasten its progress. It is remarkable that M. Louis makes no mention of this affection in 123 cases of phthisis recorded in his work.

2. *Tubercle in the Kidneys.*—Baillie was aware that tubercular deposit in the kidneys with suppuration and abscesses is very common in the lower animals, as rabbits and monkeys; he mentions that sometimes when one kidney is in a state of suppuration, the other is studded with a mass of tubercles, and from the extent of suppuration the whole substance may be destroyed, leaving only a kind of cyst. Lloyd remarks, that the infundibula are sometimes filled and distended with scrofulous matter, and other writers on scrofula refer to similar cases; but in many of these it becomes

* The Lancet, Nov. 1, 1851, p. 407.

questionable whether tubercle was ever deposited—whether the constitutional affection had arrived at that stage which admits of the aggregation of tubercle in organs; if not, they must be regarded simply as tuberculous or scrofulous abscesses.

From Louis' experience, who found tubercles in the kidney eight times only in 350 subjects, it would appear that when tuberculosis pursues its most usual course, viz., that of tuberculosis pulmonalis, tubercles are rarely deposited in these organs.

Rokitanski describes very clearly two conditions of tubercle deposited chiefly in the cortical substance of the kidney.

(*a.*) The result of intense tuberculosis, and occurring with the deposit of tubercle in many or most other organs in the form of very numerous greyish-white miliary granulations, the whole organ being swollen, hyperæmic and soft, and the urinary passages reddened and injected. When more chronic, the tubercle occurs in smaller quantity, the size of mustard or hemp-seeds, and is surrounded by pale tissue, without any trace of re-action either in the vicinity or at a distance from the deposit. This form of renal tubercle occurs especially in conjunction with tuberculosis of the abdominal viscera, and particularly of the spleen, the liver, and the peritoneum; both kidneys are generally affected; it rarely proceeds further than yellow discoloration—never to actual fusion, the patient usually dying of the general disease.

(*b.*) The deposit of tubercle in the kidney as part of a partial development of local tuberculous disease in the male urinary and sexual organs. The tubercles are very numerous, gradually accumulate into extensive groups, and coalesce into large masses; the kidney is enlarged, nodulated, and one only is extensively affected; it frequently passes more or less rapidly into the stage of softening, giving rise to tubercular ulceration and suppuration (vomica renis tuberculosa, or tuberculosis of the kidneys).

In this form, the tissues in the vicinity of the tubercle or throughout the organ are in a state of chronic re-action, appearing pale and dense, from infiltration with lardaceous matter, and the tunica albuginea is thickened. It sometimes supervenes on phthisis pulmonalis; at others, according to Rokitanski (p. 208), it is part of a local tubercular disease which primarily attacks the testes and the allied lymphatic and prostate glands, extending from these through the mucous membrane of the entire tract of the urinary apparatus to the kidneys and supra-renal capsules, and the deposit of

tubercle in the lungs and in other organs supervenes on the advanced stage of this variety of the disease. When tubercles are seated on the surface of the cortical substance of the kidney they frequently appear on separating the capsule as small, round bodies, some of which are slightly elevated above the surface, others completely imbedded in the parenchyma—sometimes isolated, sometimes congregated into masses formed into patches: they sometimes form into masses the size of a nut or almond, and resemble a tubercular lymphatic gland in the midst of healthy parenchyma.

Rayer represents tubercle in the tubular structure of the kidneys in the form of very small grains deposited in lines (pl. xlii, fig. 1, fig. 3); he has witnessed the tubercle deposited in the papillæ, both at the surface and in the substance, as a coarse powder, infiltrated, and also in small masses analogous to those which are met with in the cortical substance and in other organs. There may be no other alteration in the organ, especially when the tubercles are but few, but when they are numerous hyperæmia of the whole organ exists; sometimes certain parts of the cortical substance, or rather some of the papillæ, compressed by the morbid product, are atrophied, deformed or injected.

In 16 cases of tubercle in the kidneys in the *adult* M. Rayer found them:—

In the cortical substance	16 times.
„ tubular portion	15 „
„ mucous membrane of the calyces and ureters .	13 „

They existed six times in both kidneys, ten times in one only, and seven times in the left. In old persons renal tubercles are very rare, and limited to the tubular and cortical substances.—(Traité des Maladies des Reins, t. iii, p. 623.)

M. Ammon, of Dresden, gives a case in which the emulgent arteries and veins contained tubercular matter.—(Arch. Gén. de Med., t. xxxv, p. 462—1834.) The external coat of the kidney sometimes contains tubercle in the form of small laminar or lenticular masses in a state of crudity or occasionally softened.

Thus a tubercular kidney, together with the morbid deposit, may be hyperæmic or hypertrophied or slightly softened, or partially atrophied, and, in almost all cases, other parts of the urinary apparatus are affected.

Tubercular suppuration occasionally passes from the pelvis of the kidney to its parenchyma, and here meets with softening tubercles and tubercular abscesses.—(Rokitanski.)

3. *In Children*:—tubercles are much more frequently deposited in the kidneys than in adults; they occur in the miliary form and as grey and yellow granulations, and sometimes in large tubercular masses and caverns or cysts containing softened tubercular matter, analogous to vomicæ or glandular caverns. Miliary tubercles and grey and yellow granulations are generally limited to the cortical substance. In one case, mentioned by MM. Rilliett and Barthez, the left kidney was almost entirely converted into a pouch full of tubercular matter partly softened, and the corresponding ureter was converted into a hard tube with thickened parietes, and an internal layer of tubercular matter a line in thickness, the mucous membrane having disappeared. In a case recorded by Pasquet, the tubular substance was loaded with tubercle retaining its tubular shape; the tubercle being of firm consistence at the bases of the pyramidal masses, but softened at the calyces; the whole mucous membrane of the pelvis and calyces and part of the mammary processes were destroyed, and the pelvis contained urine in which tubercle was suspended.

Where grey granulations exist, or tubercles scattered over the kidneys, the parenchyma seldom presents any alteration, neither softening, nor local redness, nor congestion; occasionally only there is general redness of the cortical substance, and red arborizations on the surface, but never purulent infiltration.

Rilliett and Barthez never found tubercle under the mucous membrane, nor in the substance of the external coat, in the child, as seen by Rayer in the adult.

M. Pasquet is quoted as the only person who has seen tubercle extending from the ureter to the bladder, and occurring also at the neck of the bladder.

Tubercles in the kidneys in children generally coincide with an advanced state of general tuberculosis with development of tubercle in other organs, but occasionally the kidney is intensely tubercular, no other organ containing more than a very inconsiderable number.

In 312 tuberculous children 49 had tubercles in the kidneys:—

	The Right Kidney.	The Left Kidney.
Grey granulations	5	5
Yellow „	5	5
Miliary tubercles	35	34
Tubercles in masses	1	0
Caverns or tubercular cysts	0	1

In the greatest number of cases there were but few tubercles (from 1 to 8 or 10); in a smaller number they were more numerous (10 to 25), and in a few they were completely riddled with isolated tubercles, or pervaded with masses, or converted into tubercular cysts. Intense tuberculization in these cases was always met with in children at least 10 years old, with the exception of one instance.

4. *Tubercular Cysts.*—Rilliet and Barthez thus describe the most advanced stage of tuberculization of the kidneys in children, viz.,—a cyst resulting from the softening of the tubercular matter and its evacuation.

"In a youth, 18 years old, the left kidney was small, crumpled on the surface, of an irregular spheroidal form; it was transformed into ten cysts, some filled with a liquid of a urinous odour; others with a whitish matter in which white flocculi floated; others contained softened tubercular matter; lastly, a certain number, more voluminous, more consistent, contained half-softened tubercular matter. One of these cysts, larger than all the rest put together, constituted more than half the kidney. No traces of the cortical or the tubular substance could be found. The walls of the cyst were formed by a very solid, very thick, fibrous substance. Some of the cavities communicated with each other; others were obliterated. The ureter was obliterated, and reduced to a solid impervious fibrous cord."

Many illustrations of tubercle in the kidneys are extant. Carswell represents all the cavities of the right kidney of a highly tuberculous (scrofulous) girl completely filled with tubercle, the tubular portion of the organ destroyed, and the cortical portion greatly atrophied.—(Lib. cit.)

Mr. S. G. Lawrence has recorded (Medical Gazette, vol. xxiv, p. 565) a most interesting case of general tuberculosis in a boy, aged 12 years, in which the whole tract of the urinary apparatus was diseased. Several abscesses were contained in both kidneys, the pelves were ulcerated, abraded, and entirely denuded of their mucous surfaces; there were several spots of ulceration on various parts of the ureters; the bladder was contracted, empty, its muscular coat thickened, contracted, rugous and completely denuded of its mucous lining; the mucous surface of the urethra was ulcerated, abraded, and had two ulcerated holes in it resulting from a small fistulous abscess which had appeared in the urethra, in front

of the scrotum, during life; there was also deep ulceration of the meatus urinarius. A few tubercles and a small vomica were found in each lung, although the greater part of their substance was healthy. The omentum, the folds of the mesentery, and the whole of the peritoneal surface of the intestines and viscera were studded with small yellowish tubercles, but the mesenteric glands were of normal size and appearance. Out of a great number of examinations of tubercular children made during twenty years at the Royal Military Asylum, Chelsea, this was the only case of disease of the kidneys met with.

B.—THE SUPRA-RENAL CAPSULES.

They are subject to *tuberculous* (scrofulous) *enlargement.*—(Baillie.) *Tubercle* occurs in them coincidently with its deposit in other organs, especially the lymphatic glands and the kidneys and urinary organs generally; it is commonly deposited in large masses, either fused into pus and enclosed in a callous sac, or converted into a chalky concretion, invested by a fibrous tissue, in which all traces of the proper tissue of the organ have disappeared.—(Rokitanski.)

C.—THE BLADDER.

Tuberculous affections of the bladder are referrible mainly to the mucous and submucous tissue, and have been treated of in a former section. Andral states that tubercle is occasionally met with in the substance of the organ, by which I presume is meant the muscular coat, but Rokitanski does not mention such an occurrence. Ulceration sometimes extends, by secondary deposit, from the prostate gland to the bladder.

Lombard found tubercle in the bladder once in 100 phthisical adults, and once in 100 phthisical young subjects.

SECTION IX.

THE PATHOLOGICAL ANATOMY OF THE ORGANS OF GENERATION IN TUBERCULOSIS.

The pathological anatomy of the mucous membranes which comprises a considerable portion of that which relates to these organs has been already treated of (p. 128). Tuberculous lupus (p. 168), although a disease generally seated in the face and nose,

occurs occasionally on the genitals, consisting at first of indolent, red button-like prominences, then forming corroding ulcers, frequently with thick incrustations which, on falling off, show the intensity of the disease, forming sloughs and even sinuses.

A.—THE MALE ORGANS.

THE TESTIS.

1. *Tuberculous inflammation of the testis,* with swelling and suppuration, may take place without the deposit of tubercle, a purulent deposit being formed, which opening externally, is succeeded either by cicatrization or by the formation of organized fungous vegetations of a scrofulous character, or ulcers, fistulæ, and sinuses, and projecting externally through the integuments, just as happens in tuberculous lymphatic glands. Malgaigne has denominated this state of things tuberculous fungus, but it forms independently of tubercle. Sir A. Cooper describes "scrofulous orchitis."

2. *Tubercle*—not infrequently attacks the testis primarily, and its chief seat is the epididymis. It spreads from this point to the vasa deferentia, the vesiculæ seminales, the prostate and the glands connected with the organs of generation; or it may spread throughout the mucous membrane of the entire tract of the male urinary organs to the kidneys. It may also spread to the lymphatic glands of the abdomen, the thorax, and the neck, which become infiltrated with cheesy matter and strung together in large, shapeless nodulated masses.

The tubercle itself occurs in rounded nodules from the size of a mustard-seed to a pea, which coalesce into larger masses, soften, and establish tubercular suppuration or tuberculosis *orchitica.* Sometimes the whole organ is softened and transformed into a fluid, which endeavours to effect its escape through the fistulous openings in the investing coats.—(Andral.) The increase in size of the testicle varies according to the number of tubercles and the size of their conglomerations; its surface is irregular and nodulated; the tissue surrounding the testicle and the abscess becomes cartilaginous, lardaceous, and tough; and, as in other organs, inflammation of the serous investment frequently supervenes.

The disease sometimes attacks both testes; sometimes one only; in very rare cases it is limited to one point of a single testis. It is incontestible that it sometimes occurs without any corresponding

affection of the lungs, or even of any other vital organ, although it is always founded upon a tuberculous constitution. The aggregation of tubercle generally commences in the epididymis, and is thence propagated to the testis. It very rarely begins in the testis. Sometimes it progresses with remarkable rapidity; the vas deferens, the vesicula seminalis, the prostate, the urethra, and the bladder becoming involved.

The question of the seat of tubercle in the testis has lately attained an additional importance from the proposal made by some of the continental surgeons, and particularly by M. Malgaigne, to excise the diseased part when tuberculous fungus with fistulæ presents itself. He quotes two cases from Curling, in which a single tubercle occupied the body of the testis, and a case in which there were five or six, the epididymis being sound.

M. Vidal (de Cassis) affirms that tubercle limited to one testicle is associated with general tuberculosis and tubercle in the vital organs, whereas tubercle in both testes is primary as a *local disease*.—(Archives Générales, Sep. 1851, p. 92.)

Reynard found a number of miliary semi-transparent granulations in a testis.

Andral saw a case in which the external surface of the vas deferens was covered with a layer of tubercular matter in a man whose testes were full of tubercles; he considers it probable that the tubercle in this case was deposited on the outside of the tubuli seminiferi.—(Vol. ii, p. 656.)

Carswell represents the body of the testis of a young man who died of phthisis; it contained a multitude of pale yellow granular bodies evidently formed by tubercular matter in the tubuli seminiferi; the epididymis was as thick as the little finger, and its convoluted ducts filled with tubercle.—(Pl. ii, fig. 4.)

Cruveilhier represents a testicle with scattered tubercles, some solitary, some in groups of four or five, yellowish-grey, presenting different phases of development, some semi-transparent both at the centre and circumference; others presenting white caseiform points at the centre, others having a tubercular cavity. On one point of the surface of the testicle an anfractuous cavity existed containing tubercular matter opening outwards by a fistulous orifice; the head of the epididymis was intercepted by a vast tubercular abscess divided into compartments by imperfect septa; the vas deferens was healthy. The less developed tubercles appeared to be formed

in the areolar tissue which surrounds the testicular filament; the more advanced had evidently invaded these filaments. According to Cruveilhier and other authorities, this disease of the testicle is consistent with the integrity of all the other organs; it occurs in youth, and may be extirpated with success.—(Lib. iv, pl. i.)

In another case (lib. ix, pl. i.) the tunica albuginea is thickened, and separates the body of the testis from the epididymis, the latter being completely tubercular and very much enlarged—scarcely a vestige of the original structure of the epididymis remains. The softened tubercular matter here and there presented hollow foci; the body of the testis was healthy; there were some small semi-transparent grey tubercles in a state of crudity; the vas deferens was healthy. In another case only a few tubercles are disseminated in the body of the testis.

Cruveilhier regards the deposit of tubercle in this organ as the result of chronic epididymitis induced accidentally—that the body of the testis is always affected consecutively—the tubercular infiltration being either propagated by "irradiation" along the radiated fibres which penetrate the substance of the testis from the corpus higmoriani, or tubercles are deposited here and there in the substance of the testis.

Sometimes the vas deferens, the vesicula seminalis, the ejaculatory canals, and the prostate contain tubercle, as described in a former section.

In a dead subject one of the testes was enlarged and hard, there were some grey tubercles in its body, the epididymis was scattered with innumerable white tubercles, the vas deferens was healthy, as it proceeded from the epididymis, but arrived at the abdomen its size increased, became whitened, and presented alternate enlargement and contraction; the vesiculæ seminales were enlarged, extremely hard and puckered; on dividing the vas deferens it contained tubercular matter at all the nodular points, differing at different parts in consistence, and adhering more or less strongly to the parietes—the vesiculæ seminales were converted into hollow tuberculous cells; the ejaculatory canals were full of tubercle which distended them like a solid injection, the substance of the prostate at its centre contained a great number of crude tubercles. The other testis contained a cavity full of softened tubercles at the head of the epididymis.

THE PROSTATE GLAND.

Desault, Baillie, and Hunter, describe "scrofulous" abscesses in this gland. Baillie found white curdy matter resembling that which is met with in a scrofulous gland, and he forced scrofulous pus out of the prostate ducts. Tubercular matter has been detected by the more recent morbid anatomists. Abscesses form by the softening of tubercle, and spread by secondary deposit and further softening, by which they extend beyond the gland and discharge themselves around and within the neighbouring parts, producing great devastation. Great disparity exists in the statistics of this part of the subject: in 350 cases Louis found tubercle in the prostate 27 times; Lombard only once in 100 cases. Tubercle in this gland is very frequently—Rokitanski says always—complicated with tubercle in the testes and the allied organs.

Tubercles in the male organs, as here described, are said never to occur before puberty; but I met with a case myself of a tubercular testis with tubercular mesenteric glands in a child three years old, the subject of hereditary tuberculosis in an aggravated degree.

B.—THE FEMALE ORGANS.

THE MAMMARY GLANDS.

Hypertrophy of the breast occurs occasionally in tuberculous subjects. John Hunter mentions a case in which the gland weighed from sixteen to eighteen pounds. Circumscribed scrofulous tumours of a much smaller size are also occasionally met with: they are attended with various degrees of acute or chronic inflammation. It has been thought that scrofulous disease of the breast is very common, but Sir A. Cooper, with his large experience, rarely encountered it.

In one form the disease is incidental to young females of the tuberculous constitution. It generally commences as a hard, moveable lump, rather flattened than rounded; smooth on the surface, but irregular at its edges. The skin is not discolored, and does not at first adhere to the tumour. It is sometimes of slow growth, free from pain, and frequently disappears; at other times it comes on more suddenly, coalesces with the neighbouring parts, inflames and suppurates, forming a chronic abscess, or a succession of abscesses, and these not infrequently terminate in ulcerated openings or a fistulous passage, which Warren has

known to penetrate through the intercostal muscles, pleura, and lungs, forming a communication with the bronchiæ without great inconvenience to the patient.—(On Tumours, p. 215.) It occasionally happens that the skin of the under part of the breast where the abscesses are seated becomes discolored and diseased. The matter discharged is scrofulous.

Lloyd describes another form of scrofulous disease of the breast occurring in adults, or rather the same form differing somewhat in its progress.—(On Scrofula, p. 86.) The whole gland enlarges and becomes firmer than natural, the skin remaining soft and unconnected with it; it continues imperceptibly enlarging for months or years, unattended with pain or tenderness; suddenly the surrounding parts inflame and unite with the gland; at length it shows a disposition to suppurate partially; a small abscess forming on some part of its surface, with great pain, and ultimately discharging about a tea-spoonful of a curdy, whey-like matter through a very small aperture, a slight discharge continuing for weeks, after which the aperture closes and a new abscess forms pursuing the same course. Abscesses will continue to form successively for several months, until the tumour gradually diminishing, the whole breast wastes away. During the formation of the abscesses the breast often feels nodulated, but sometimes appears as if there were several soft places or pits on the surface of the tumour.

These affections of the mammæ have not the hardness of scirrhous, and there is an absence of the retraction of the nipple which appertains to cancer.

Notwithstanding these affections it is a remarkable fact that some of the most experienced morbid anatomists have never detected tubercle in the mammæ.

THE OVARIES.

Tubercle.—Notwithstanding that Rokitanski denies the occurrence of tubercles in these organs, Louis met with them 17 times in 350 cases; Lombard found them twice in 100 adult subjects, and not at all in children. Boivin, Dugès, and Tonnellé met with them.—(Journ. Hebdom., t. v, p. 149.) A case occurred recently at St. Mary's Hospital, and is recorded by Dr. Tyler Smith.—(London Monthly Journal, Feb., 1852.) Other instances are dispersed in medical works.

THE UTERUS.

1. *Atrophy.*—Dr. Montgomery has directed attention to this condition of the organ which sometimes occurs in tuberculosis pulmonalis.—(Lancet, 1843-44, vol. i, p. 835.)

2. *Tubercles* are sometimes imbedded in the walls of the uterus. —(Louis, Lombard.) Louis found them once in 350 cases.

Rokitanski states that tubercle occurs primarily in the uterine mucous membrane, the parenchyma being only attacked secondarily in its early stage, which is rarely observed. It exists in the form of scattered grey granulation; but it generally occurs in an infiltrated form, the lining membrane being converted into a fissured, cheesy, purulent mass of tubercle, and the uterine cavity containing tubercular pus, retained by closure of the os uteri, may cause a globulous distension of the organ.

Uterine tubercle is frequently complicated with tubercle of the fallopian tubes, and in the latter situation the development of the tubercle is further advanced than in the former; constituting, as respects the local development of tubercle, the primary disease. In the tubes the mucous membrane is almost always completely disorganized and the tubercle infiltrated throughout the parietes, which become indurated and the tube filled with yellowish-white, purulent, cheesy, or lardaceous matter, sometimes cracked and friable, rendering it tense, swollen and tortuous. Rokitanski describes the fimbriated extremity as presenting a very peculiar appearance—the mucous membrane being infiltrated with tubercular deposit is pushed out in the shape of a cauliflower excrescence, and everted upon the peritoneum.

Tubercle in the uterus is also found complicated either with mesenteric or peritoneal tubercle, and may serve as a passage of discharge from the abdominal cavity. It is rarely translated to the urinary passages. The deposit generally stops at the cervix, rarely passing beyond the internal orifice, and, according to all the pathologists whose works are before me, the vagina is never affected; thus in several particulars contrasting with carcinoma.

Tubercular ulceration of the cervix may sometimes result from tubercular granulations deposited in that situation, but the occurrence must be rare. Louis refers to a case also in which the cervix was almost as hard as cartilage, the cavity presenting from within outwards—1, an uneven tuberculous structure easily removed by scraping—2, a papillary-like surface of the thickness of a sheet of

paper, having the yellow colour of tubercle—3, underneath this tissue the uterus of a greyish colour, slightly transparent—more deeply of a dull white and fibrous aspect—and deeper still perfectly natural; both fallopian tubes contained tubercular matter; there had been no discharge of pus or matter, and there was no vaginal ulceration. In Dr. T. Smith's case above referred to the interior of the uterus was lined with tubercular matter.

Uterine tubercle occurs during childhood, in the period of puberty, during the prime of life, and occasionally but rarely during the decline of life.

SECTION X.

PATHOLOGICAL ANATOMY OF THE ORGANS OF LOCOMOTION IN TUBERCULOSIS AND OF THE TISSUES AND STRUCTURES MORE IMMEDIATELY ASSOCIATED WITH THEM.

This system comprises the voluntary muscles, the osseous system and the structures connected with the articulations. The deviations from the physiological standard of this system, and of the bones in particular, in their minor shades, as contributing to mark the predisposition to tuberculosis, were fully described in the first chapter, but it is also subject to more decided pathological lesions, which I proceed to detail.

A.—THE VOLUNTARY MUSCLES.

There are very few diseases in which the muscles become so completely atrophied as in tuberculosis. They occasionally undergo the fatty degeneration, are liable to inflammation, and occasionally contain tubercle.

1. *Tuberculous Inflammation of Muscles.*—The muscles are liable to inflammation essentially tubercular, but for the most part secondary to tubercular disease of the bones—(Rokitanski.) The products of this inflammation soften like tubercle and may be regarded as tubercular. Tuberculous inflammation in the interior of the bodies of muscles also occasionally arise in phthisical subjects, independent of disease of bone; they present an exudation of a tubercular nature, giving rise, as they break down, to the formation of a tubercular vomica in the muscle. (Idem.)

2. *Tubercle*:—has occasionally been met with in its defined form, but it is questionable whether it occupies any other site than the laminæ of the intervening areolar tissue. It occurs in the muscles

of the lower animals, the hare, for instance.* Lombard twice met with tubercles in the intercostal muscles of the adult human subject. Perhaps the most remarkable case is described by Laennec.—In a consumptive patient in whom tubercles were deposited in almost all the organs, the lower extremity of one of the sterno-mastoid muscles was converted into tubercular matter, firm and consistent; but the muscular structure was still preserved in the parts most altered. In those least altered, and which passed by insensible gradation into the sound portion, the tubercular matter was in its early stage grey—and semi-transparent.—(Lib. cit., p. 291.) Andral in four instances found tubercle occupying the areolar tissue between the muscular fasciculi.

Rokitanski remarks that tubercles are occasionally deposited in muscles in consequence of their vicinity to other affected organs, and this is particularly the case with the organic membranous muscles, as those of the intestines beneath tubercular ulcers of the mucous membrane, and in the voluntary muscles of the thorax in connection with softened tubercles in the lungs and pleura.

B.—THE PERIOSTEUM.

The periosteum is liable to inflammation in tuberculous subjects; like other tuberculous inflammations, the periostitis has a highly suppurative tendency. Sometimes it involves the deposit of new osseous matter between the internal surface of the periosteum and the surface of the bone; sometimes it leads to caries and necrosis.

Tubercle and tubercular deposits in the Periosteum.—These consist of thickening and induration of the tissue, and of effusion of serous and purulent or caseous substance into or beneath its thickened tissue. They frequently occasion a hard and painless swelling which, in a cylindrical bone, usually occupies its whole circumference. Such deposits are common on the fingers of children. They occur also on flat bones, occasioning a firm, solid swelling. This disease is often with difficulty distinguished from disease of the bone itself. Even when suppuration and effusion take place, owing to the softening of all the tissues, there is very little pain or constitutional irritation, yet it may lead to diseased bone. It sometimes occurs in the periosteum of several bones simultaneously, or in quick succession. It requires to be dis-

* Dr. Crampton—Transac. Irish Assoc., vol. v.

tinguished from tuberculosis of bone, for, although frequently followed by superficial ulceration and small exfoliations from the bone, the disease is curable without deformity; whereas, in tubercular disease of bone, deformity must ensue, the destruction of the bone not being followed by reproduction. When it occurs near a joint it is apt to involve the synovial membrane, and destructive inflammation of the joint may accrue.—(Stanley on the Bones, p. 348.)

C.—THE PERICHONDRIUM AND CARTILAGES.

Without entering into the question whether true cartilages in their physiological state are subject to inflammation, properly so called, they frequently undergo changes expressed by the terms erosion and ulceration which ensue from inflammatory and other affections of the neighbouring parts, and occur especially when the perichondrium is inflamed and purulent matter is effused on its surface. Cartilages liable to ossify, as those of the larynx and ribs, have that change induced in them in tuberculous subjects when inflammation occurs in their vicinity.

These ossified cartilages are liable to ulceration both from without and within. When this occurs from without, minute ulcers penetrate the mucous membrane till their base is constituted by the denuded perichondrium; tubercle is deposited, softening and inflaming the perichondrium, and ultimately exposing the subjacent ossification, which then gradually crumbles away. When it occurs from within, the rarer case, tubercle is generated immediately within the cellular spaces of the ossified cartilages; softening, producing caries, forming an abscess, and opening into the larynx.

Ulceration sometimes reaches the cartilages before they have become ossified; and Hasse states that he has more than once found tubercle deposited between the cricoid and one or more arytænoid cartilages, when no true ulcers were observed in the larynx. Louis, although denying the formation of tubercle in these parts, found the cartilaginous rings of the trachea occasionally completely denuded, attenuated, and partially destroyed. In five cases the mucous membrane of the trachea from one end to the other of its fleshy part was completely destroyed; in one case the cartilaginous rings were cut through.

The fibro-cartilages are subject to acute inflammation in tuberculous as in healthy subjects, and to rapid ulcerative destruction.

This inflammation sometimes occurs in the intervertebral cartilages, terminating sooner or later in suppuration, leading to inflammation and caries of the bodies of the vertebræ and of the membranes of the spine. Andral once found a mass of tubercles in the intervertebral cartilages.*

The pathology of the cartilages is intimately associated with that of the other structures constituting the articulations, and will have to be referred to in a future section.

D.—THE BONES.

The bones are a very common seat of tuberculosis in all its local forms. After the lungs perhaps the most common seat. Lebert found them affected in half his cases of scrofula. Inflammation terminating in the formation of pus and ulceration—suppurative osteitis—and that terminating in exaggerated nutrition, hypertrophic osteitis—abscesses encysted and surrounded by a pyogenic membrane—osteitis tending to necrosis—tuberculous hypertrophy of the medullary membrane dilating the areolæ, and producing *spina ventosa*—and the deposit of tubercles in the isolated and infiltrated forms—are among the most prominent pathological changes. Dr. Hérard (Arch. Gén.) records that—

In 180 scrofulous children the bones were affected in . . 122
„ 75 „ adults „ „ in . . 25

1. *Tuberculous (scrofulous) Osteitis.—The density of the Bone diminished.*†—At the commencement the spongy tissue—its ordinary seat—becomes congested and infiltrated with a violet-reddish fluid; the medullary membrane takes a rosaceous tint, contrasting remarkably with the white colour of the neighbouring cartilage; the osseous laminæ become thinner; the areolæ enlarged, and at this period a probe will readily penetrate through their meshes, thus rendered thinner and more fragile. Very soon the natural adhesion between the bone and the neighbouring cartilage becomes less firm, and the slightest traction is sufficient to separate them, leaving the surface of the bone rugous or granular, friable, and generally infiltrated with sanious fluid. After a time the infiltration of bloody fluid is replaced by purulent matter; the spongy tissue then becomes grey, yellowish, sometimes greenish; the friability

* Path. Anat., by Townsend and West, vol. i, p. 524.

† Condensed from Dr. Hérard's Essay, Arch. Gén.—Sec. iv, t. xix, p. 408.

augments; the disease reaches the external surface of the bone and propagates itself to the surrounding soft parts; these thicken, inflame, and suppurate. Lastly, fistulæ become established in the skin, from which pus of tuberculous quality issues, containing minute portions of bone.

At an advanced period the cartilages are destroyed either by absorption, or they are broken up in the suppurating process. The short bones, as, for instance, those of the tarsus, become separated from the soft containing parts, and remain loose in a suppurating cavity; they then gradually decrease in size, and ultimately become a mere debris of bone, floating in the pus like a piece of sugar steeped in water, and this debris may ultimately be entirely broken up and absorbed. M. Gerdy calls especial attention to this absorption of bony matter which explains most of the circumstances attending tuberculous inflammation of bone.

Tuberculous Osteitis (The density of the bone increased).—This is a much less frequent occurrence than the former; it affects especially the long bones of the extremities. The effects of the inflammatory process are in the first instance much as in the former case, but suppuration once established the osseous tissue acquires a remarkable hardness; the cells appear to be obliterated as if filled with some internal secretion; the compact tissue presents, on cutting, the appearance of a stone sawn through. These two varieties in the effects of tuberculous osteitis may occur together even in the same bone.

Caries.—This may result from either form of tuberculous osteitis. It is a more advanced stage of the morbid effects seated in the superficial parts, and is analogous to a tuberculous ulcer following inflammation of the skin. Caries is one of the most frequent results of tuberculosis.

Necrosis.—This is of two kinds. 1. *False necrosis*—characterized by sequestra of various shapes and sizes detached from the inflamed bone. On washing them all the characteristics of one or other kind of inflammation of the bone may be observed. The isolation of the bone necessarily entails its death, and this kind of necrosis is produced by caries. 2. *True necrosis.* In this case a portion of bone is completely separated from its vascular connection, either in consequence of periostitis, or a secretion of pus or tubercle between the bone and the periosteum, inflammation taking place around the part so as to effect its elimination. The

sequestra eliminated are compact, and do not resemble those above described and there is an effort of nature to replace the bone, which does not occur in the first case.

Tubercle in Bone.—Bone is a very common seat of tubercle. It occurs most frequently in cancellous bones, as—1. The bodies of the vertebræ. 2. The spongy articular extremities of the long bones, especially the lower end of the femur, the upper end of the tibia, and the ends of the bones which compose the elbow-joints. 3. The carpal and tarsal, the metacarpal, and metatarsal bones and the phalanges. 4. The sternum. 5. The ribs; and 6. The cranium, more rarely.

Tubercle is seated sometimes in the outer layer of bone and the periosteum, but most frequently in the inner cancellous texture.

(*a*) It occurs as *grey crude granulations* in the spongy tissue occupying the membrane which lines the Haversian canals and the cells. As the granulations accumulate they form larger masses, and partly compress the bony structure and partly include necrosed fragments of it amongst them. The aggregate deposit is sometimes found as a yellow cheesy mass, but much more frequently it is softened, and consists of a cream-like greyish-yellow pulp, or a thinner, flocculent, tubercular pus. It is contained within a more or less complete lardaceo-callous cyst, which is, in fact, the tissue surrounding the softened tubercle infiltrated with lardaceo-gelatinous material. If it occupy the outer part of the bone and the periosteum, the latter and the tissues over it partake in the formation of the cyst; if it advance deeply into the bone, it is mostly the only rudiment of the cyst that can be proved to exist. As in the soft parts, tubercle in bone is subject to *softening* and to the *cretaceous* transformation.

(*α*) When it softens a tubercular ulcer forms. The loss of substance arises from the necrosis of the portion included in the tubercular mass, the vessels becoming obstructed or destroyed; and it may die either when first involved or at a later period. When it occurs at the surface, the bone presents the appearance of being unevenly corroded; when larger and more deeply situated, the bone is excavated, and a tubercular cavern results. The cavern contains a fluid composed of tubercular matter mixed with bony particles, sometimes small, resembling crumbled mortar, sometimes larger, of a dirty white colour, soaked with tubercular matter, and not so brittle as the sequestrum produced by other processes in a spongy bone.

In the neighbourhood of the cavern there is a secondary deposit of tubercles, which, as they soften, increase its size. The congestion to which this is owing usually advances to inflammation, and the formation of a gelatinous granulating lining which, as the tubercles soften, breaks down also. In the peripheral layer of a bone, this congestion, vascularity, and product, are seen distinctly extending to the periosteum, and may be found in the adjoining cellular and fibrous tissues. After the inflammatory process becomes more intense and in a highly advanced state of general tuberculosis, it pervades the osseous tissue throughout with a yellow cheesy product which breaks down at once, occasioning a rapid enlargement of the ulcer, and extensive destruction of the bone and the neighbouring tissues.

(β) When the case has been more favourable and the formation of tubercle has ceased, the inflammatory product at the wall of the cavern becomes organized into a fibroid, lardaceo-callous tissue, and that in the bone itself into bone; the cavern changes into a thick, firm cavern, surrounded by an indurated bony tissue; its contents are partly absorbed, and partly, as the capsule shrivels, they become inspissated into a greasy calcareous pulp, of a greyish-yellow colour, or a kind of mortar which encrusts the walls, or a chalky concretion. Thus, under favourable circumstances, the disease is cured and the tubercle converted into chalk inclosed within indurated osseous tissue; or, if on the surface, the concretion is covered on the outside by thickened periosteum.

(*b*) *Tubercular Infiltration.*—This is generally referred to tuberculous or scrofulous inflammation of bone, furnishing a tubercular product with which the inflamed spot becomes infiltrated. It is a common affection in young persons, and comprises the Pædarthrocacia of the older writers, Pott's disease, and other affections.

It may be a primary affection, or supervene on the deposit of tubercle. When it occurs in the spongy bones they are at first partly of a dark red colour, injected, and extrude a fatty gelatinous matter; and partly pale, having their cells filled with softening tubercular exudation; both bone and periosteum are frequently swollen, and the former is elastic and soft, and yields easily to the knife; ulceration begins; the fluid discharged is thin, greyish, or yellowish, and mixed with cheesy flakes, necrosed particles, or with a dirty-brown, firm, hæmorrhagic exudation; or it is highly discoloured, blackish-green, extremely offensive, and mixed with black

fragments of bone, and particles of the soft parts destroyed by sloughing. When it occurs in a compact bone, as of the skull, the cavities of the bone appear to be filled with tubercular exudation, and the bone becomes necrosed, and forms a sequestrum. A similar tubercular product is exuded between the bone and the periosteum. If the process be limited to a superficial layer, the bony tissue is partly lost amid the softening of the tubercular matter, and partly thrown off in palpable particles, exposing an uneven, rugged surface, from which the process extends more deeply, the osseous tissue previously becoming indurated, and the bone enlarging.

The abscesses produced by the above processes advance in various directions from the bone into the soft tissues which are infiltrated by the gelatino-lardaceous matter. After having given rise to other secondary, congestive abscesses, they open externally at a part often far removed from the original seat; particularly when the disease is in the vertebræ. When the contents of the abscess have been evacuated, or have partly cretified, the tuberculous caries heals, leaving an indurated cicatrix in the bone, which deforms it in proportion to the amount of substance lost. The cicatrix has a rugged and nodular, streaked and radiated, or knotted appearance, and adheres to the thickened and callous periosteum.

Mr. Stanley, after describing scrofulous abscesses of bone, says (Lib. cit. p. 33): "It is probable that, in some cases, a deposit of tubercle has preceded the circumscribed abscess in bone, and that the tuberculous matter, mixed with purulent fluid, has then passed out of the bone, leaving a cavity in the bone analogous to the tuberculous cavity in the lung. Such appeared to have been the character of the disease, in instances where I found masses of tuberculous matter, mixed with purulent fluid, filling excavations in the articular ends of bones communicating with the adjacent joints."

A youth, 20 years of age, suffered from the symptoms of pulmonary phthisis, during which he received a severe blow upon his leg. In the examination of his body, tubercles were found in the lungs, also in the cervical, axillary, and mesenteric glands. At the part where the leg had been injured, the periosteum was found separated from the tibia, and there was here a round cavity in the bone, the size of a hazel-nut, filled by a yellowish-white substance,

which, at its circumference, was solid, and could be crumbled in the fingers like curd.

Mr. Stanley, (Lib. cit. p. 250,) after stating that it is well ascertained that tubercle is occasionally deposited in the bones of more than one joint at the same time, makes the important remark that — more frequently when tubercular deposit is found in the bones of one joint, the primary changes from *scrofula*, not yet advanced to the tuberculous stage, are found in other bones; thus, for instance, in limbs removed on account of disease in the knee-joint, accompanied by tubercular deposit in its bones, the bones of the ankle-joint are often found softened, slightly expanded, with their cancellous structure excessively vascular, and its cells filled by a serous and bloody fluid.

Tubercle frequently occupies several adjoining bones at once, as the ends of the bones which form a joint. Young persons are especially subject to it in childhood and at puberty, but it is also frequent in later and even in advanced life.

On analysis of a tubercular bone Dr. Bostock found;—a small proportion of earthy matter;—entire absence of carbonate of lime; —an unusually large proportion of oil or fat nearly equal in amount to the gelatinous base of bone;—albumen, appearing to have its ordinary structure nearly destroyed, and to be in a disorganized state.

One of the most remarkable circumstances connected with tubercle in bone is its frequent occurrence without being met with in the lungs, or any other of the viscera. Of this I have abundant evidence before me, and as it frequently happens in the adult it is one of those circumstances which tends to modify the conclusion arrived at by Louis, that tubercle is almost invariably deposited in the lungs when it is deposited in any other tissue after the age of fifteen. "Whilst in some instances I have found tubercles in the lungs co-existing with tubercle in the bones, in others, when tuberculous deposit had taken place in the bones of a diseased joint, yet the lungs were sound." (Stanley, p. 250.)

It has been remarked that in Upper India the bones next to the lungs are the most frequent seat of the local development of tubercle. In the Museum of the Bengal Medical College, No. 1388 shews—in an emaciated aged Hindoo of middle age—universal tuberculosis of the bones. The exostoses are in some places two inches long; the majority of tubercles when cut into in a fresh state exhibited

the usual "grey semitransparency," and the internal viscera were not affected. The bones of the head alone were free; the spinal column and sternum were dotted all over with tubercles; the ribs on the right side, especially the second, third and sixth, presented large elevated tubercles; in the tenth rib there was a large excavation, and in fact all the ribs were tubercular, as also the os innominatum, and the whole lower extremity. Numerous other cases are described.*

(*c*) *Tubercle in the Vertebræ.*—Mr. Stanley states (p. 311) that the vertebræ become soft by diminution of their earthy constituents, and tubercular matter is diffused through their cells; it is often at the same time deposited in large quantity upon the front of the spine beneath its fibrous coverings, even to the extent of forming a solid circumscribed tumour, projecting into the cavity of the chest or abdomen. Illustrative cases are frequently met with: for instance:—

In a case described by Mr. Partridge, in the Pathological Journal,† the lower dorsal and upper lumbar vertebræ had cavities opening on their surface, and containing more or less tubercular matter, extending deeply into the cancellous structure of three of the bones, so that they had yielded to pressure and produced a gentle curve observed during life; tubercle affected five of the vertebræ, and extended beneath the interior common lateral ligament, and laterally beneath the adjacent pleura costalis. This disease of the bones was associated with psoas abscesses, and old adhesions between the surfaces of the pleuræ, and with old cavities in the lung containing tubercular matter. The case is highly important as illustrating the pathology of tuberculosis, and especially its curative tendency, and the essential identity of "scrofulosis" and tuberculosis.

(*d*) *Tubercles in the Bones of the Cranium especially in children.*—The pathology of the cranial bones furnishes the basis of some very distinct forms of tuberculosis. MM. Rilliett and Barthez have some important remarks on this subject. These bones are frequently affected from the pressure of tubercles deposited in the substance or in the membranes of the brain. They may be compressed, absorbed and perforated. Tubercle also is sometimes found deposited in the substance of the bones; either

* Pathologica Indica, by Allen Webb, 1848. p. 127.

† Report, 1849-50, p. 264.

encysted or infiltrated; disorganizing the bone, perforating the cranial walls, forming fistulous communications between the cranial cavity and the organs of sense or the external air. These tubercles are especially deposited in the bones of the cranium :—

1. At a distance from the organs of sense.
2. In the neighbourhood of the orbits.
3. In the neighbourhood of the ethmoid bone.
4. In the os petrosum.

When perforation takes place externally, inflammation and ulceration of the pericranium and hairy scalp, followed by fistulæ, occur, and when the tubercular deposit has been evacuated, and the sequestra detached, the ulcers and fistulæ have been known to heal.

When developed in the superior part of the orbit they may produce exophthalmia. When in the neighbourhood of the ethmoid bone, they may perforate the cribriform plate, and occasion disorganization of the interior of the nasal fossæ, involving the destruction of the bones of the nose. Laennec published the case of a child who had a deep ulcer in the temple, discharging fœtid pus during life, in whom, after death, a perforation of the bone, and almost complete destruction of the maxillary sinus, was found; so that, but for the pituitary membrane, the pus would have been discharged by the mouth; there were tubercles situated near the mastoid process, and the posterior angle of the occipital bone.

MM. Rilliett and Barthez give four cases in which tubercle was deposited in the os petrosum, occasioning tuberculous, chronic otitis. They were accompanied with complete destruction of the membrane of the tympanum, the middle and internal ear being converted into a vast depository of greenish, thick liquid, in which a great number of flocculi swam. In three cases no vestige of the internal ear remained, and in the fourth a large detached scale contained the cochlea and a portion of the semicircular canals. The auditory and facial nerves could not be traced into the internal ear. In these cases sometimes the cerebral surface of the os petrosum remains entire; at others, the dura mater becomes involved, being red, soft, mammillated and tubercular; sometimes the lining membrane of the external auditory canal is similarly affected; or the canal is denuded of its pericranium, and this latter shows the effects of tuberculous inflammation. In two cases

a large perforation existed behind the ear, with an artificial opening between the interior of the canal and external surface.

MM. Rilliett and Barthez believe that in these four cases the bone was primarily affected. All the subjects were tuberculous in a high degree. They consider that the disease of the bone was not caries; the bony tissue was neither black, nor soft, nor crepitant, only infiltrated with pus, and it separated by voluminous sequestra. They consider that the brain in contact with the diseased bone was only affected after the destruction of the dura mater; after which occurrence adhesion of the surfaces of the arachnoid first took place, and then the cerebral substance became superficially affected. In two of the cases tubercles were met with in the encephalon, or in the pia mater.

These facts prove the importance of chronic otorrhœa as a symptom of disease in tuberculous subjects.

E.—THE ARTICULATIONS.

The pathological anatomy of the articulations involves that of the cartilages, bones, periosteum, perichondrium, areolar, adipose, muscular, and cutaneous tissues already described; and also the pathological anatomy of the synovial membranes, which is closely analogous to that of the serous membranes.

The articulations are much more frequently affected in that stage of a tuberculous condition of the system in which the blood is not matured for the deposit of tubercle, and accordingly, in early life, although occasionally they are primarily, or in their tedious course become consecutively, complicated with tubercle either deposited in the bones connected with the joints or in distant organs. Although among the most serious affections which afflict tuberculous subjects, tuberculous affections of the joints are upon the whole more tractable and less fatal than internal tuberculosis. Of the large number of cases treated as scrofula by Lebert one-seventh had affections of the joints.

The skin and the subcutaneous areolar tissue surrounding joints is frequently the seat of abscesses, ulcers and fistulæ. Scrofulous ulcers and abscesses around joints are generally superficial and present the same characters as similar tuberculous affections elsewhere; they have violet coloured and flabby edges and a pale base covered with the products of exudation and thin pus. The flabbiness of the edge is less marked here than in the neck, owing to the

skin not being so loose. There may be one or more ulcers around and in the neighbourhood of a joint, and these superficial affections frequently correspond with deeper seated diseases. Sometimes they are of great extent and they exhibit two forms, being either ulcerous aud purulent or fibro-plastic.

The muscles which surround articulations are subject to various alterations in connection with the diseases to which the joint is subject. Their tendons frequently become retracted and adhesions are formed. Sometimes the substance of the muscles undergoes the fatty degeneration, owing to their long continued inaction.

But it is the synovial membranes which are the most frequent and very generally the primary seats of organic disease in the joints of tuberculous subjects. Tuberculous affections of the synovial membranes are in many respects identical with the tuberculous affections of the serous membranes generally; they differ in others, and especially, at all events in the early instance, are more frequently associated with other signs of external scrofula than with the deposit of tubercle in any of the viscera. There is also some difference in their organization, and considerable difference in the functions they have to perform, which modify their pathological conditions. Yet there can be no doubt that the so-called "scrofulous affections" of joints, and of this membrane in particular, owe all that is specific in their history to the tuberculous state of the blood and the tuberculous organization of the tissues which form the joint, and that the pathology of these affections belongs to the general subject of tuberculosis as a disease of the blood.

The fibrous structures entering into the formation of and surrounding the joints are liable to lose their elasticity, and to form adhesions; to œdematous and purulent infiltrations; to hypertrophy of their fibrous tissue and infiltration of fibro-plastic elements. The capsules, the ligaments and the intra-articular cartilages change their appearance in proportion as their structure is deteriorated. They first lose their white shining tint, and become yellow and dull; their fibrinous structure is loosened, and by degrees they take on the lardaceous or gelatiniform aspect of the newly formed fungous tissue, which will presently be described as surrounding the whole joint. Their primary fibrous structure disappears gradually and appears to give place to a new fibro-plastic and fungoid tissue, prolongations of which occasionally extend between the neighbouring muscles.

1. *Tuberculous Synovitis.*—Under the term synovial membrane is included the subsynovial areolar tissue which covers its external surface. The affections of the joints to which tuberculous subjects, with disease of the blood to that extent only which I have described as a predisposition, are so extremely liable, frequently consist in or take their origin from inflammation of the synovial membrane. Under the designation of scrofulous affections, they are treated of by all surgical writers. Tuberculous synovitis is accordingly a common occurrence in young persons; it assumes for the most part a chronic form, but may be acute or sub-acute, and the greater part of the pathological appearances presented by the synovial membrane are mainly attributable to it. These appearances are in many respects analogous to those presented by the pleura and the peritoneum. The synovia becomes a turbid, dirty, reddish fluid, sometimes thin and very abundant, sometimes thicker than usual, and frequently mixed with pus and with flocculi of fibrine or false membrane. The membrane loses its smooth and polished aspect, and becomes papilliform or velvety, of a more or less vivid red colour, sometimes presenting ecchymoses, closely resembling the granulated conjunctiva of long continued chronic inflammation and it ultimately degenerates into a gelatinous, soft or pulpy, white or greyish substance. Lebert describes, more particularly, the microscopic aspect of these membranes in their state of increased vascularity—sometimes they are uniformly reddened from a general increased development of vessels; sometimes they present a series of minute deep red papillary eminences on a rose-coloured base, produced by a circumscribed and disseminated development of vessels, at numerous points in which may be recognized tortuous, interlaced, vascular nooses, the vessels being triple the calibre of their natural condition, gorged with blood plasma, and surrounded by very slightly vascular interstices. The membrane then soon loses its smooth and polished aspect, owing to the disappearance of its epithelium (Lib. cit., p. 375) and the deposit of a fibrous layer infiltrated with serosity, which gradually assumes the form of a fibro-plastic tissue, becoming unequal and rugose. In rare and exceptional cases, the epithelial layer increases in volume before it disappears, and its folds are then frequently infiltrated with fatty granules. The sub-synovial areolar tissue is frequently the seat of a more or less abundant fibro-plastic effusion, sometimes red and vascular, sometimes pale and of a fibrous aspect, and the

adipose tissues surrounding the joint may, in like manner, become infiltrated with fibro-plastic elements. Sometimes pseudo-membranous flocculi cover the internal surface of the highly injected synovial membrane; and purulent effusion into its cavity occurs, although not very frequently. The false membranes increase in extent, and are sometimes deposited in super-imposed layers, but Lebert never found them adherent and vascular as in the pleura and peritoneum; although it is quite possible they may become organized. Microscopically they appear to be composed of fibrine interspersed with pus globules. The pus is generally mixed with synovia and of less consistence than ordinary pus, and the pus globules are frequently deprived of their nuclei; it also contains curdy concretions, fatty elements, and blood corpuscles, and in some rare cases the false membranes undergo a kind of cretaceous transformation, and contain amorphous mineral masses.

The synovial and sub-synovial tissues in the chronic inflammation of tuberculous subjects also generally undergo that particular transformation which has been called *fungoid* or *lardaceous*. This, according to Lebert, consists of a simple fibrous or fibro-plastic hypertrophy, so frequent a consequence of chronic inflammation. The tissue around the articulation becomes generally of a pale yellow colour, of an elastic consistence, and by pressure it yields a yellowish transparent juice. Under the microscope it presents a fibrous net-work, in which alternates a tissue composed of fusiform bodies, with a more decidedly fibrous tissue, and in the liquid there are divers fibro-plastic elements mixed with liquid or vesicular fat. This tissue may retrograde and become pale from undergoing a more complete fibrous transformation, or it may increase in vascularity, and present a deep red or flesh colour. Bonnet, of Lyons, concludes, from chemical experiments, that these fungosities of the synovial membrane are analogous to false membranes, differing only by the blood which penetrates them, and the capillary vessels which permeate their substance. They are sometimes so intimately associated with the synovial membrane, that the latter cannot be distinguished; sometimes it can be seen that the membrane still exists, being only slightly thickened, the fungoid mass belonging almost altogether to the subjacent tissues. When the disease retrogrades, the fibro-plastic tissue may sometimes be detected externally by palpation, or it may form into irregular, indurated, and to a certain extent cartilaginous masses. When these fungosities

occupy the whole extent of the membrane, the latter is sometimes plainly defined externally.

This degeneration of the synovial membrane in tuberculous subjects frequently results in ulceration, which may take place from without inwards, or from within outwards, and destruction of the subjacent cartilages is the result. Their destruction is called erosion by those who deny the vascularity of cartilages, and ulceration by those who admit it. Lebert says, "the cartilages lose their elasticity, and become eroded and more and more altered in structure without being inflamed." Pus also frequently finds its way from the joint to the external surface, the destruction of the subsynovial tissues rapidly advancing, the ligaments become disintegrated and relaxed, the bones inflamed, the whole of the textures irreparably injured, the entire joint disorganized, and luxation may occur. In other cases, tuberculous inflammation of a joint, whether proceeding from the synovial membrane or otherwise, may remain comparatively indolent, the cartilages being absorbed. The affections of joints originating in the synovial membrane in tuberculous subjects, require to be distinguished from those described as originating in the bone in the same disease, which are frequently produced by a deposit of tubercle. Chronic synovitis in tuberculous subjects occurs especially in the hip-joint, the knee, and the elbow.

Tuberculous synovitis frequently occurs together with other local external tuberculous affections, as superficial ulcers, glandular swellings, &c. This membrane is also sometimes eroded and perforated from without, owing to abscesses which have their origin externally. Its specific nature is best determined by reference to the existence or non-existence of those constitutional symptoms which I have described as characterizing a tuberculous condition of the blood.

2. *Tubercle in the Synovial Membrane.*—Some difference of opinion appears to exist as to the fact of the deposit of tubercle in the synovial membrane. A fatty deposit is frequently met with, sometimes in considerable quantity, on the internal surface of the membrane, and becomes the seat of a fibro-plastic infiltration, which has been regarded as tubercle. Lebert states that its colour is deep yellow and its aspect shining; it is soft and elastic, greases the scalpel, and under the microscope it presents adipose and fibro-plastic elements but no tubercle corpuscles, and he denies its

tubercular character. According to Rokitanski, the synovial membranes are the seat of tubercle as a product of inflammation, the inflammation co-existing with that of other large serous membranes, and occurring in advanced tuberculosis of other parenchymatous organs, in a high degree of general tuberculosis. When the exudation softens and suppurates, the capsule of the joint ulcerates, and secondary tuberculosis and tubercular ulceration of the bones ensue;* but when a joint is generally affected with tuberculosis, the morbid deposit occurs for the most part in the structure invested by the synovial membrane, (viz., the bone,) to a certain extent corresponding with that which happens elsewhere, as in the lungs; tubercle being much less frequent in the pleura than in the lungs.

Certain analogies manifestly exist in the tuberculous affections of the synovial membrane and those which have been described as occurring in the serous membranes. Certain very obvious differences also present themselves. The latter are not more marked than would be predicated from the differences of cell growth in the formation and nutrition of these membranes, the differences arising from the mechanical structure of the joints, and the difference in their natural fluid secretion. Affections of the joints in tuberculous subjects most frequently occur in youth, very frequently in those who are previously in comparative health, and who are most subjected to external and accidental exciting causes of disease—in those in whom the blood is not matured for the production of tubercle. They accordingly, as before stated, associate themselves with those affections which are designated as scrofulous in contradistinction to those which are unequivocally tuberculous, but their history, progress, and termination are altogether referrible to the diseased condition of the blood which it is the object of this work to illustrate.

The cartilages of the joints first lose their elasticity and their smooth and polished aspect; they imbibe the various fluids effused into the cavity, the fluid imbibed is sometimes tinged red, and this is regarded by some pathologists as the circumstance which has countenanced the idea entertained and strongly supported by others of the existence of true inflammation. The cartilage is soon eroded on its surface, and loss of substance in small irregular points, as if made with a punch, is perceived. M. Richet has

* Path. Anath., Syd. Edit., p. 296.

seen the whole cartilage porous. In this way the cartilages may be completely worn away, and occasionally, partially or wholly detached. When altogether detached, there is generally found at the extremity of the denuded bone a layer of fleshy granulations, which have been mistaken for granulations arising from a layer of synovial membranes between the cartilage and the bone.

Inflammation of the bones is sometimes the primary affection of a joint. This has already been described. The areolæ fill either with purulent fluid which has sometimes been described as tubercle, or with fungosities which, as they develope themselves, render the laminæ thinner and thinner, and extending to the surface of the compact tissue, terminate by detaching the cartilage.

Besides this fungous osteitis sometimes the articular extremities are affected with hypertrophic osteitis, occurring under the periosteum or in the substance of the bone, and producing osseous stalactitis externally or internally, concentric hypertrophy, and elimination.

When osteitis is consecutive to arthritis it frequently terminates as when primary, by caries, fistulæ, necrosis and the formation of sequestra. Frequently the pus from the inflamed bone is poured into the articulation, and gives rise to secondary synovitis. M. Richet has seen osteitis propagate itself to the opposite extremity of a bone, there being a red tint along the medullary canal, and here and there sanguineous effusions.* When the articular extremities are rough, they sometimes become impacted with the corresponding bones either by bony projection or by cellulo-fibrous adhesions, thus producing true or false anchylosis; the friction of the articular surfaces may also render these bones again soft, and, according to M. Richet, a new cartilage may even be formed on their surface.

The affections of the joints of a tuberculous nature have specialities according to the particular joint affected, and have received different denominations, and are treated of by surgical writers accordingly. In the ilio-femoral articulation they come under the designation of *coxalgia*, and the disease, owing to the peculiarities of the structure and functions of the joint, runs its particular course. In the knee-joint they are generally known as *white swellings*. They are very frequent in the tibio-tarsal articulation, and very serious in their consequences. In the elbow-joint their

* Annales de la Chirurgie Française, 1841, t. xi, p. 5—129.

course is very specific; they are subject to less effusion into the joint, retraction of the fore arm follows at an earlier period, and the curative tendency, comprising anchylosis and retraction of the tendons, rather than the destructive tendency with disorganization of the bones and ligaments, prevails. Occasionally both elbows are affected at the same time in the same individual, which is rarely met with in the other joints (Lebert, p. 405).

The pathology of tuberculous affections of individual bones and joints is well described by Sir B. Brodie, in his work on the joints and in his pathological lectures. It is unnecessary to enter into the minute points of difference in all these cases in the present volume, but the following description of a "scrofulous" knee joint will serve to complete the illustration of that form of the general disease which locates itself in the bones and joints.

After describing the preliminary morbid changes, as above, Sir Benjamin states in substance—"These changes in the condition of the bones are followed by others which affect the cartilages. The surface of the bone to which it is connected is more vascular than natural, and the vessels may be seen, in certain cases, extending from it, and carrying red blood into the substance of the cartilage itself. At this period the cartilage seems to adhere rather less firmly than ordinary to the bone. It may be peeled off in a way which could not be done in health, and when removed, spots of ulceration are observable on the under surface where it was in contact with the bone. In the space between the ulcerated surface of the cartilage and the bone there is a deposit of a small quantity of very vascular lymph. Ulceration being once established it extends through the cartilage in one spot, and that spot afterwards increases in diameter. The same thing happens in other parts of the cartilage, and ultimately the ulcerative process destroys the whole.

"In some cases the cartilage may be destroyed to a considerable extent without the occurrence of suppuration. For the most part, however, suppuration occurs at an early period. The deposit of pus does not take place in the whole joint at once. There may be one collection of pus between one condyle of the femur and the corresponding surface of the head of the tibia; then another collection in some other situation; these different abscesses being separated from each other by deposits of lymph and adhesions. Hence, there may be two or three, or even more abscesses in the joint

distinct from one another. Whilst these are being formed the ulceration of the bone advances, till at last a considerable quantity becomes absorbed. The abscesses steadily, but very slowly, find their way to the surface. The consequence of the complicated structure of the knee-joint is, that the abscess seldom comes directly straight to the surface. It runs first in one direction, and then in another, where there is the least amount of resistance, forming numerous and circuituous sinuses. When it presents under the skin, the process of ulceration goes on but slowly, and it may sometimes be perceptible for three or four months, or even longer, before the final escape of its contents.

"The bone being more vascular than natural at first, afterwards becomes less so, and sometimes it perishes, leaving a portion of dead bone in the joint, which at last separates, making the case hopeless." *

A general idea of the frequency with which different joints are affected may be formed from the following:—

Table of the seat of disease in 114 cases of scrofulous disease of the articulations from M. Lebert.

The articulations of the foot	32
,, ,, knee	31
,, ,, hip	21
,, ,, elbow	21
,, ,, wrist	4
,, ,, shoulder	1
Multiplied affections of joints	4
	114

Of 114 cases 84 were complicated with other scrofulous or tuberculous affections.

Simple complications with diseases of the bones	34
,, ulcers and abscesses	13
,, diseases of the eyes	5
,, diseases of the skin	2
,, otorrhœa	1
Double complications with diseases of the bones and ulcers	20
,, ophthalmia and ulcers	1
,, diseases of the skin and ulcers	1
,, disease of the skin and caries	1
Triple complications	5
Quadruple complications	1
	84

* Abstract by Dr. Ranking. Report on Surgery, p. 233.

In 119 cases of diseased joints Lebert found nine only complicated with the deposit of tubercle. He has seen softened tubercle previously deposited in the bone effused into the cavity of the articulations.

SECTION XI.

THE PATHOLOGICAL ANATOMY OF THE MORE COMPLICATED ORGANS OF SPECIAL SENSE IN TUBERCULOSIS.

A.—THE EYE.

The various structures of the eye are the frequent seats of tuberculous affections, and particularly of tuberculous inflammation, but rarely of the deposit of tubercle. Lebert met with "scrofulous" ophthalmia in nearly a fifth part of the cases of scrofula submitted to his observation. For the most part they are cases of ophthalmia produced by ordinary causes in tuberculous subjects, before the blood is ripe for the deposit of tubercle, and are seated especially in the superficial membranes of the organ, and, like all the inflammatory affections in tuberculous subjects, they have a tendency to ulceration and chronic purulent discharge.

The best account I am acquainted with of tuberculous (scrofulous) affections of the eyes is by Mr. Middlemore, in his "General Treatise on Diseases of the Eye." The following description of the pathology is in great part condensed from that work.

1. *Tuberculous (scrofulous) Ophthalmia.*—The pathological appearances of the eye indicative of this affection are;—a redness, generally very partial and very slight; sometimes merely a few enlarged conjunctival vessels, passing nearly in a parallel direction towards the cornea, and terminating in a minute phlyctenula; a small white prominence, the cavity of which contains a thin, whitish liquid, resembling dirty serum, or a small pustule, much larger than the former, and containing pus or a fluid of a purulent character. In these we see the analogues of the erosions and ulcerations of the mucous membranes generally in tuberculosis. These phlyctenulæ or pustules occasionally form upon the sclerotica at some distance from the cornea, sometimes upon the cornea itself; they may or may not degenerate into extensive ulcers, but they always leave behind, for a longer or shorter period, an opacity of a variable size and density. The vascularity of the conjunctiva is not equally diffused; one or two much enlarged trunks, or a pencil, or fascicu-

lus of swollen vessels frequently occurs. On everting the lids the conjunctiva of the lid is found much redder than that of the sclerotica, but not more so than in proportion to its relative degree of vascularity in health; in advanced stages the vascularity is increased, and in very severe and protracted cases this increase extends to the sclerotica, cornea and iris; but in no case does it reach that equally diffused vascularity which attends other forms of inflammation. The muscles and other structures around the eye are frequently thickened; the eyebrows depressed; the integument between them puckered into ridges; and the circulation of the blood, being interrupted by the violent action of these muscles, the free return of the venous blood is liable to be interrupted; the veins, from the thinness of their parietes, are enlarged and distended, and the face presents a flushed and turgid appearance. After the continuance of the affection for some time, the eyelashes are found to be very long, very thick, extremely numerous, and set in double or triple rows.

The pustules or phlyctenulæ are not invariably attendant on tuberculous ophthalmia, although they are more frequent in this than in any other form of ophthalmia except the purulent. Their most frequent seat is the circumference of the cornea, where they are always attended with a pencil of vessels at the point or termination of which, they form, the vessels not extending beyond their margin. Middlemore accounts for the latter circumstance by the intimate adhesion between the sclerotica and conjunctiva in this situation becoming a decided impediment to the enlargement of the blood-vessels. The phlyctenulæ on the cornea leave behind them small circumscribed nebulæ, which soon disappear, but a pustule leads to a more dense, extensive and durable opacity; it may proceed to ulceration and if unchecked may penetrate through the whole of the layers of the cornea, producing evacuation of the aqueous humour and prolapsus of the iris. An ulcer of the cornea may occur in tuberculous ophthalmia without the formation of a pustule, ulcerative absorption taking place without being preceded by any evident degree of opacity or inflammation, resembling the non-inflammatory erosions of the mucous membranes in tuberculous subjects. There is a remark by Dr. Watson, in his lectures on the Practice of Physic (vol. i, p. 318), that it has not been clearly ascertained whether the phlyctenulæ or pustules result from the deposit of tubercular matter.

(*a*) *Tuberculous Inflammation of the Cornea.*—The pathological appearances, especially those constituting inflammation, more frequently extend from the conjunctiva or iris than appear as a primary affection of the cornea, but in either case it is distinguished from ordinary inflammation of the part by being slower in its progress, and accordingly of longer duration; the zonular arrangement of vessels around the margin is less obvious, there is a more distinct pale, cloudy, bluish-white appearance; the cornea is more prominent, as though projected forwards by an increase of the aqueous humour; the pink appearance of the sclerotica is more decided and more equally diffused over the surface of the eye, so that the zone is less definite and distinct, and its peripheral margin is so gradually shaded off that it is difficult to say exactly where it terminates. When erosions, ulcerations or pustules have cicatrized they leave specks and nebulæ sometimes amounting to *leucoma*, and Lebert states, that when these specks are examined microscopically, a *granular* matter is detected between the laminæ of the cornea, and sometimes an epithelial layer of new formation.

(*b.*) *Tuberculous inflammation of the membrane of the aqueous humour.*—The pathological appearances resemble those which belong to simple inflammation of the same membrane, except that they are rarely so intense; the opaque spots referred to an extension of the inflammatory action to the lamellar texture of the cornea are less frequently observed, and effusion of lymph upon the iris, and into the aqueous humour does not take place so frequently, and seldom to so great an extent; the arrangement of pink vessels around the cornea is trivial; there is dulness of the aqueous humour; a deeply-seated and nearly uniformly and equally clouded state of the cornea; a haziness of the iris, without any distinct and decided change of its colour, its mobility, or the state of the pupil.

Considering this as a very fine serous membrane these pathological appearances may be associated with those presented by the other serous membranes.

(*c.*) *Tuberculous inflammation of the Iris.*—A zone of pink vessels is observed around, often extending to or creeping along the cornea, but the redness is not so great as in any other form of iritis except the arthritic; this zone is not equally distinct throughout its circumference, coinciding with a difference in the degree of inflammation in different parts of the iris; sometimes the conjunctival

covering of the cornea is vascular, in a greater or less degree; in other instances the red vessels pass more deeply between the laminæ of the cornea; or there may be an aggregation of vessels producing a spot or patch of redness upon the cornea; the conjunctiva and sclerotic participate in a slight degree; the iris loses its polish and brilliancy, but it is not until some time that its colour becomes changed; it does not readily undergo those changes of texture which occur speedily in idiopathic and syphilitic inflammation; the affection may continue some time, and may often relapse, before permanent change of colour occurs; but ultimately the same changes take place, as in ordinary iritis; its pupillary border may become irregular, and it may acquire adhesion to various parts. The cornea and membrane of the aqueous humour are sometimes conjointly affected, and rendered so turbid that the iris cannot be discerned, but the affections of these structures are by no means necessary concomitants of tuberculous iritis. —(Lib. cit., p. 703.)

(*d*) *Tubercle in the Iris.*—Dr. Jacob states that in "scrofulous iritis" deposits as in syphilitic iritis occur, but in the former they do not resemble those in the latter—they consist of true tubercular matter,—and instead of being absorbed, as lymph and the syphilitic deposit would be, they increase in bulk and either burst as an abscess externally, or sometimes, but very rarely, are discharged into the aqueous humour. This, Dr. Jacob remarks, is the most characteristic and unequivocal proof of the nature of the disease. The tubercular deposit generally takes place towards the circumference of the iris, near its junction with the ciliary ligament, and consequently under the margin of the cornea; it is at first a small, yellow, irregular mass, with red vessels passing over it, as in the deposits in syphilitic iritis; but it gradually enlarges and extends under the margin of the cornea, beneath the sclerotica, which gives way before it, and allows a prominent yellow mass to project beneath the conjunctiva; this continuing to enlarge, assumes the appearance of an abscess, and in some cases becomes so prominent and irregular in form, is so enveloped in enlarged and tortuous vessels, and presents so peculiar an appearance, from the dark choroid coat appearing through the attenuated sclerotica around it, that it has sometimes been supposed to be of a malignant nature.

In the case of an unmarried lady, of about 26 years of age, the whole eyeball became filled with a firm yellowish mass, presenting

all the appearance of tubercle, and suppurating at several points, so that Dr. Jacob could pass a probe in different directions, nearly from one side to the other. The contents gradually crumbled down and escaped with purulent discharge, leaving ultimately a shrunk and retracted sclerotica in the bottom of the orbit, and so little of any other morbid condition that she was able to wear an artificial eye without uneasiness. In a scrofulous girl, of eight or ten years of age, a yellow tubercle, the size of a pea, formed in the iris during inflammation, burst near the margin of the pupil, allowing the contents to escape into the aqueous humour; in which, however, they were not diffused, but remained in a solid state until they were ultimately absorbed.*

Illustrative of the frequency of tuberculous affections in relation to all other diseases of the eyes and their appendages, and of the relative frequency of the different tuberculous affections, I have before me M. Cunier's statistical researches, published in the year 1847.

Of 641 cases of all diseases of the eyes among the indigent, treated at the Ophthalmic Institution at Brussels, in 1845, there were 214 "scrofulous affections"; that is to say, affections of the eyes occurring in tuberculous constitutions; as follows:—

Scrofulous Ophthalmia	103	
Inflammation of the Membrane of the aqueous humours (Discemétites)	4	
Ulcerated ciliary ophthalmia palpebrarum	10	The sequelæ of tuberculous ophthalmia, pure or mixed.
Entropion	4	
Cellular pannus	15	
Albugo, with synechia anterior	2	
" " " and occlusion of pupil	1	
Specks on the cornea	20	
Incrustations on the cornea	7	
Opaque staphyloma	10	
Convergent strabismus	7	
Vascular pannus	21	
Tumours of the lachrymal sac	3	
Fistulæ	7	
	214	

In addition to this, the tuberculous constitution complicated 42 cases of catarrhal, purulent, rheumatic and gonorrhœal ophthalmia, rendering the proportion of scrofulous cases two-thirds of the whole number.

* Dr. Ranking's Abstract, vol. vi, p. 268, from the Dublin Medical Press. 1846.

Also, in a visitation to the province of Brabant, it was found that of 1782 ophthalmic cases observed among the poor and labouring part of the population, chiefly in the rural communes, 640, that is to say 36 per cent., were scrofulous:—

Scrofulous Ophthalmia	267	
Inflammation of the membrane of the aqueous humours (Decemétites)	10	
Entropion	8	The sequelæ of tuberculous ophthalmia, pure or mixed.
Ulcerated ciliary ophthalmia palpebrarum	42	
Convergent strabismus	16	
Specks on the cornea	20	
Incrustations on the cornea	37	
Albugo	10	
„ with synechia anterior	12	
„ „ „ and obliteration of pupil	19	
Obliterations of the pupil	16	
Vascular pannus	27	
Cellular pannus	29	
Tumours of the lachrymal sac	10	
Fistulæ	2	
Opaque staphyloma	18	
Transparent staphyloma	3	
Atrophy of the globe of the eye	33	
Catarrhal ophthalmia 38; of the army 3; rheumatic 10; gonorrhœal 10;—in the scrofulous constitution	61	
	640	

M. Cunier finds from the statistics drawn up by M. Beer at Vienna, M. Kranichfeld at Berlin, M. Benedict at Breslau, M. Weller at Dresden, M. Andreæ at Magdebourg, M. Blasius at Halle, M. Fischer at Prague, MM. Mensert and Blom in Holland, M. Carra du Villards at Luxembourg, and M. Ansiaux at Liege, that the general proportion of tuberculous ophthalmia, simple or mixed, in the whole number of cases of ophthalmia is about 23 per cent., and although M. Sichel of Paris, M. Stœber of Strasbourg and M. Rosas of Vienna, found only 20 per cent., the difference appears to have resulted from the latter not having included secondary tuberculous affections and complications. M. Cunier considers during a series of years that about 25 per cent. is the average proportional frequency of "scrofulous" inflammatory affections, primary, secondary and complicated, in the whole number of diseases of the eyes which occur. According to the reports of the Ophthalmic Hospital Charing Cross, and the Liverpool Ophthalmic Infirmary, the proportion in this country is about the same.

The proportion of scrofulous cases in the total number of eye diseases occurring in the towns was 61 per cent., whereas in country places it amounted only to 23 per cent.

Any form of inflammation of the eye may occur in tuberculous subjects and be modified by the tuberculous condition of the blood, but the above statistics indicate the affections which most frequently occur.

Tuberculous ophthalmia may thus involve all the important and deeper seated structures of the eye, and may result in closure of the pupil; adhesion of the iris to the capsule of the lens or the cornea; prolapse of the iris; staphyloma; pannus or permanent increased vascularity of the cornea, destroying its transparency, &c. Onyx and hypopyon are stated by Lebert to be rare occurrences in tuberculous subjects.

In the inflammatory affections of the eyes in tuberculosis the tears frequently produce eczematous and impetiginous eruptions on the face. Both eyes are generally affected, but the inflammatory signs are frequently more intense alternately in each eye.

Of 162 individuals affected with "scrofulous ophthalmia," Lebert found 42 complicated with glandular or internal tubercles, and 120 without any such complication. It is a disease of that time of life at which the blood is more liable to be affected with the degree of tuberculosis which leads to these kind of inflammatory affections rather than to the deposition of tubercle. Of 160 cases in which the age was noted, 149 occurred before 20 years. Of the 162 cases, setting aside the 42 cases complicated with tubercle, 93 were complicated with other local tuberculous affections, according to the following table:—

Affections of the skin alone	34
Affections of the skin with simple swelling of the glands; or with caries; or with ulcers or white swellings	10
Affections of the bones as a sole complication; or with other local affections	34
Ulcers or abscesses as a sole complication	3
Affections of the articulations alone	4
Ulcers and glandular engorgement without the deposit of tubercle	1
Ulcers and white swelling	2
Otorrhœa	3
Vaginitis	2
	93

Thus it would appear that of the 162 cases of ophthalmia in tuberculous subjects, 27 only occurred without other tuberculous affections being present at the same time as the ophthalmia.

2. *The Meibomian Glands and Tarsi*—are the frequent seats of general or partial hypertrophy. Sometimes this state of hypertrophy passes into encysted tumours of the eyelids. These glands also inflame and suppurate, forming styes (Hordeolum). Or the inflammation becomes chronic and habitual, and the edges of the eyelids thickened or even ulcerated. The eyelashes become matted and curved inwards (Trichiasis), and ultimately atrophy of the bulbs takes place, the hairs fall off and are replaced only by very fine white hairs; the edges of the lids become permanently red, nodous, hairless, and ectropium is ultimately formed.

3. *The Lachrymal Gland.*—This is subject to temporary enlargement during tuberculous ophthalmia, and to more permanent hypertrophy from its long continuance or frequent repetition. Wiseman says these glands are often affected with scrofula. (Tract. 1692, p. 261).

Andral records that "in a man who lost his left eye two months before his death, there was found in the centre of the optic nerve a small hard tubercle of a greyish colour, and somewhat larger than a grain of hemp-seed." (Path. Anat., vol. ii, p. 802.)

B.—THE EARS.

Tuberculous affections, both "scrofulous" and tubercular, of the various structures of the organ of hearing are of very frequent occurrence in the subjects of tuberculosis. The external parts of the ear, the pavilion and the commencement of the external auditory canal are frequently the seat of eczematous and other eruptions, and of habitual pellicular desquamation. The purulent tendency of tuberculous blood is exhibited in obstinate and long-continued otorrhœa, frequently arising from apparently trivial causes, and depending upon inflammatory and tubercular affections of the membranes, bones, and other structures, and these affections of the ear frequently extend to or are complicated with similar affections of the dura mater and brain.

1. *External Otitis.*—Inflammation for the most part sub-acute or chronic of the *external* and *middle ear* is a very common occurrence in tuberculous subjects. This is attended with suppuration, the membrane is more or less internally red, and presents a

velvety appearance, at first partial and circumscribed; resembling a mucous membrane affected with chronic inflammation; and this red, velvety, and pyogenic tissue is continued over the anterior surface of the membrane of the tympanum. The bottom of the ear sometimes contracts, not only from the morbid state of the cutaneous surface, but from an hypertrophy of the subjacent, cellular tissue, and sometimes from the same cause the whole canal is contracted. The affection is generally chronic. The tympanum is sometimes but rarely perforated from without.

2. *Internal Otitis* also occurs in tuberculous subjects, and its pathological effects are much more serious, involving caries of the os petrosum, and perforation of the membrane of the tympanum. This affection is so intimately associated with the diseases of bone from tubercular deposit that it belongs more especially to the subject of tuberculosis of the bones, and has been described in the section relating thereto. It is sometimes confined to the bony case of the internal ear which surrounds the bones proper to the organs of hearing; at other times it occupies a greater extent, and frequently extends to the Fallopian tubes, and involves the structure of the facial nerves; at other times it extends to the mastoid portion. The bone becomes as it were worm-eaten; the osseous areolæ dilate and become infiltrated with sanious and fetid pus, terminating in necrosis. It is generally confined to one ear, while external otitis most frequently occurs in both. It always terminates in suppuration, the abscess opening generally by the outer ear, although occasionally by the Eustachian tubes.

When the brain is involved there are two series of pathological phenomena—in the one case there is pus in the brain with destruction of one of the phases of the os petrosum and the corresponding dura mater; in the other case there is an abscess of the brain without erosion of the os petrosum or dura mater.

Where the os petrosum is destroyed several views have been taken. Avicenna, Bonnet, Haller, and others, maintain that the inflammation commences in the brain, and progresses from within the cranium to the ear. Morgagni and others, that it progresses by continuity from the ear to the brain. Lallemand, that it neither proceeds from the brain to the ear nor conversely, but that commencing primarily in the ear the brain subsequently becomes affected with a distinct inflammatory attack, owing to its proximity to the seat of the disease.* Some important cases of

* M. A. Bérard, Dictionaire de Médicine, t. xxii, p. 371.

this nature by MM. Rilliett and Barthez, with the authors' observations, are described in the section on Tubercles in Bones.

3. *Tubercle in the middle Ear.*—A case is recorded in the "Gazette des Hopitaux" in which tubercle was found in the middle ear, and permeating the whole of the os petrosum, but no trace of it in the lungs or elsewhere. It is stated in this paper that tubercles occur in the middle ear attended with otorrhœa and painful deafness, that they sometimes precede pulmonary phthisis, and that the ear affected, and the lung subsequently so, are generally on the right side. In the case here referred to the youth suffered violent pain, deafness ensued, and this was followed by delirium and death.* The following case is confirmatory of these views.

In the Pathological Journal Mr. Toynbee describes a case of phthisis in which death, at 44 years of age, was preceded for some years by deafness and otorrhœa on the *right side*, produced by a cold taken at the age of 14, which deafness had continued, with the exception of a month or two, for 30 years. The dura mater covering the upper surface of the petrous bone was thin, and at one spot, about a line in diameter, it was soft and pulpy, and of a leaden hue; there was an orifice in the bone forming the upper wall of the tympanic cavity; the mucous membrane of the tympanum was entirely destroyed by ulceration, except a small patch here and there; the stapes was absent; the internal wall of the canal for the passage of the portio dura, for two lines and a half, had been destroyed by caries, and the portio dura nerve was bare; it was of a dark colour, half its substance soft and pulpy; a portion dark and pulpy formed a small tumour, which projected downwards and partially filled the fenestra ovalis, left open by the absence of the stapes. (Report, 1849-50, p. 270.)

4. *Tubercle in the substance of the Membrane of the Tympanum.*—M. Louis quotes M. Ménière on this occurrence as a cause of impaired power of hearing and actual deafness in tuberculous subjects.

SECTION XII.

THE PATHOLOGICAL ANATOMY OF THE CONTENTS OF THE GRAVID UTERUS IN TUBERCULOSIS.

A.—THE PLACENTA.

Rokitanski states that tubercle does not occur in the placenta—

* The Lancet, Jan. 28, 1843.

that is to say, he never observed it. Nevertheless, M. Hardy found crude tubercles in a phthisical patient on the external surface of the uterus under the peritoneum, and eight or ten on the uterine surface of the placenta.* Dr. Barnes has lately described a granular, oily deposit in the placenta, and consecutive degeneration of its proper tissue, and considers its occurrence by no means infrequent, but whether this is in any way analogous to the fatty condition of other organs which occurs in tuberculosis has not been noticed.†

B.—THE FŒTUS.

Although Rokitanski admits that it occurs in very rare instances, he never met with tubercle in the fœtus, a circumstance somewhat extraordinary since his examinations are understood to have extended to twelve thousand. Tubercle has been found by other pathologists in various organs.

1. *The Lungs of the Fœtus.*—Billard, Lombard, West and others, met with tubercles. Mr. Langstaff's museum contained two cases of tubercular lungs found in a fœtus. M. Husson saw in the lungs of a fœtus born at seven months tubercles softened and suppurating. Velpeau and Breschet, as well as Rokitanski, never found them, nor did M. Guizot, who examined four hundred still-born children. On the other hand, M. Graetzer (on Diseases of the Fœtus‡) affirms, that tubercles in the lungs are not infrequent, but it is not usual for them to have passed the crude state during intrauterine life, although instances to the contrary have been related by Husson and also by Cruveilhier; and in one instance Lobstein found calcareous concretions in the lung. Miliary tubercles were found by Armstrong in the lungs of new-born children and in every instance the mother was "tuberculous or tabid" during gestation. Dr. D. Kennedy presented to the Pathological Society of Dublin the lungs of a fœtus which had never respired, containing tubercles in the crude and also in the softened state, they were of various sizes, some as large as peas, and dispersed through various portions of the organs.§

Of 139 cases of death of new-born infants from pneumonia recorded by E. C. J. Vallaix,‖ in one only tubercles existed; the

* Arch. Générales, Juin, 1834. † Med. Chirurg. Transac., vol. xxxiv, p. 200.
‡ Brit. and For. Med. Review, Jan. 1841, p. 215. § Dublin Journal, vol. xv, p. 300.
‖ Clinique des Maladies des Enfans Nouveaux, 1838, p. 68—69.

whole inferior lobe of the left lung had a greyish aspect and sunk in water, from general tubercular infiltration, formed in great part by semi-transparent grey granulations, among which were groups of tubercles twice the size of a mustard-seed, some solid, and some softened—but without caverns;—the pulmonary tissue of the diseased lung was greyish, thick, and hard. There were traces of inflammation of the pleura with *old* adhesion at the base of the left lung, and yellowish-white well organized false membrane of considerable consistence and recent formation between the two lobes. At the centre of the upper lobe there were a few nodules of indurated lung, but the pneumonia invaded especially the right lung.

2. *The Liver of the Fœtus.*—Several writers affirm that there is an excess of the natural hypertrophy of the liver in the fœtus; but whether in the fœtus of tuberculous mothers, or in that of fœtus as with tuberculous disease, I am not aware. Husson met with softened tubercles in the liver of a child born at the full period, but who lived only eight days. Tubercles have been found in the liver especially in the fœtuses of animals.

3. *The Glands of the Fœtus.*—M. Chaussier met with suppurating glands in fœtuses and new-born infants. Œhler with the mesenteric glands tumefied, hard; in a word, scrofulous, not only in fœtuses born of scrofulous mothers, but also in some whose mothers presented no trace of the disease.* Billard found manifest tubercular disease of these glands it two still-born children. Graetzer does not notice tubercular deposits in the bronchial glands, although it is asserted that they are more frequently met with in these glands than in the lungs, in the fœtus as well as in the infant.

4. *The Peritoneum.*—Billard found tubercular granulations of the peritoneum of an infant who died four days after birth.

5. *The Supra-renal Capsules.*—Andral states that these have been found converted into purulent pouches in fœtuses and new-born children.

C—THE THYMUS GLAND.

The facts relating to tuberculosis of this body revealed by pathological anatomy would be of considerable importance if we knew its functions. The gland is stated by some pathologists to be very little subject to inflammation from common causes; by others,

* Baudelocque Etudes sur les causes de la Maladie Scrofuleuse, p. 7.

this is regarded as problematical; in some rare cases it has been known to suppurate; on the other hand, it is very liable to tubercular deposit and all its consequences.

Burns, Kopp, and especially Mr. Hood, of Kilmarnock,* have described the diseases of this gland in infancy. Its pathology is referrible almost entirely to scrofulous or tuberculous subjects.

(*a.*) *Hypertrophy.*—The thymus is very liable to enlargement in tuberculous fœtuses and young infants, and sometimes acquires considerable dimensions, even filling the anterior mediastinum. Its development being opposed outwardly by the sternum it is liable to compress the larynx and the large blood-vessels and nerves of the neck; hence, although sometimes attended with no functional disturbance, at others its enlargement gives rise to dyspnœa and other symptoms, and may become the anatomical cause of thymus asthma, laryngismus stridulus, and probably other morbid conditions.

An hypertrophied thymus gland is found, on incision, denser, heavier, and more fleshy than usual, and it may exude a milky or cream-coloured fluid.

(*b*) *Tubercle.*—Lieutaud, Heister, Hoffman, Portal, and the more recent pathologists have recorded many cases of tuberculization of the thymus; the tubercle being sometimes crude, sometimes softened, and, for the most part, co-existing with pulmonary tubercles. Cruveilhier delineates (lib. xv, pl. ii, f. 2) a thymus gland from a fœtus apparently tuberculous; it was very large and dense, and covered the heart—the lungs were indurated. Mr. Hood describes the deposit of tubercle, or a substance resembling cheese, and also abscess and ulceration, as being in some cases the morbid element of the crowing disease of infants, and as occurring in association with tubercular diseases of other organs.—(Edin. Journ., Jan., 1827, p. 39.) Dr. Montgomery gives a case of an infant who died suddenly; firm tubercle was found deposited in the thymus, and the trachæa was flattened by it; there was also extensive glandular disease in the mesentery, effusion on the surface of the brain; the upper aperture of the chest appeared to be of unusually small dimensions, and the heart was empty and wrinkled.†

Hasse states, that tuberculous affections of this gland are very

* Edinburgh Journ. of Med. Science, Jan., 1827, p. 39.

† Dublin Journal, vol. ix, p. 436—note.

common, and he considers that many cases of tubercular softening have been mistaken for inflammatory suppuration. He also quotes Becker and Hangstedt, who cite fifteen cases of different-aged persons, the subjects of general tuberculous disease, in whom the thymus was found involved. It was for the most part hypertrophied; firmly united with the surrounding parts; either converted by tubercular infiltration into a hardened mass, or else partially destroyed by softening. In three or four cases calcareous concretions were found in the gland.

Tubercular disease of this gland may thus occur in the fœtus, although it is most commonly met with in early infancy; but it is not confined even to this period, as shewn by the above statement. Sir A. Cooper, also, gives a case in which he met with it in a patient nineteen years old.

SECTION XIII.

ADDENDA TO THE PATHOLOGICAL ANATOMY.

A.—VARIÆ.

1. *Fibrinous Clots in the veins of the Extremities.*—In Section V, p. 220, it was omitted to be mentioned that the principal veins of the right or left limb, or more rarely both, sometimes where œdema has existed, contain throughout a clot of black coagulated blood, easily detached by the finger, but adherent to the internal membrane and sometimes by more organized fibrinous layers, at the site of the valves and where the veins join, constituting a kind of envelope to the clot. The whole calibre of the vessel is obliterated, its walls a little thickened, but its internal membrane retains its colour and polish. In the case of one young man there was inflammation of the left iliac vein and the clot contained a considerable quantity of greenish and sanious pus.*

2. *An open Foramen Ovale.*—Mr. Abernethy's notion that the foramen ovale is sometimes reopened, which was also entertained by Meckel, is noticed at page 223. It is there omitted to be stated that, in reference to the cases generally, it has been questioned whether the opening had existed from birth. This condition has been met with in other diseases besides phthisis. Bezot regards it as insignificant; he met with it even less frequently in phthisical subjects than in others.

* Compend. de Méd. Prac., tom. vi, p. 500.

3. *Atrophy of the Heart.*—The evidence of atrophy of the heart corresponding with the general atrophy of tuberculosis is more conclusive than already stated (p. 291). Bouillard believes this atrophy would be constant if it were not for inflammatory affections, as endocarditis and pericarditis, and especially the former which have a tendency to produce hypertrophy. He states that atrophy of the organ occurs as a symptom of tuberculosis (phthisis), while in the cases where it is wanting, and especially where the heart is hypertrophied, this result is met with, not *because* the patient is affected but *although* he is so affected. (Clin. Med. p. 482.) Dr. Stokes has also directed attention to atrophy of the heart, and especially of the valves, which he has found thin and perforated and even cribiform. (London Med. Gazette.)

4. *Curving in of the Nails* in phthisis is generally associated with a *fusiform swelling* of the last digital phalanx; (noticed at pages 22 and 28). M. Pigeaux directed his attention to this particular subject and satisfied himself that the change in the points of the fingers precedes, and is the cause of the curvature of the nails. It consists chiefly of an œdematous infiltration of the pulp of the fingers, by which the nail becomes mechanically forced outwards and forwards, and thus its end is curved round. The swelling begins at the articulation of the third with the second phalanx, and increases somewhat towards the root of the nail, which becomes the most projecting part, and then it tapers off to the end of the finger; the thumb and forefinger are generally first affected; its progress does not so much depend upon the local disease as on the general state of hæmatosis. It occurs in some other affections besides tuberculosis. M. Pigeaux observed it in 167 out of 200 cases. He saw it increase, diminish, and even vanish, with the removal of the cause which had produced it—this cause not being at all times tuberculosis. It is more common in women than in men, and much more rarely seen in the toe-nails than in the fingers, with the exception of that of the great toe, the swelling of which and the convergent growing of the nail into the quick often gives rise to much pain and annoyance. This pathological sign existed in $^{6}/_{10}$ths of the consumptive patients, and upon the whole it was more frequently seen in those who still retained their embonpoint than in those who were much emaciated. So that he regards it as one of the earliest signs and as such useful in diagnosis.

According to M. Pigeaux, the nail separated from the finger

appears very little, or perhaps not at all curved, but when in situ it is found to be elevated and pushed forwards by the infiltrated pulp *underneath*. The bone is not altered. (Archives Générales, 1833.)

5. *Collapse at the Upper part of the Chest.*—This has been described as a part of the tubercular predisposition, but it increases after local disease sets in and frequently attains a very high degree before the death of the patient. Miliary or granular tubercles when in considerable number cause a contraction of the lung, chiefly at the upper part, and a corresponding collapse at the upper part of the chest. In many cases a sinking in of the infra-clavicular region is induced, and is sometimes found after death before softening or excavation has taken place; but the collapse is aggravated in more advanced stages by the contraction which the deposits themselves undergo.

6. *In the Pathology of the External Lymphatic Glands* (p. 226)—may be added the frequency with which the glands of the different regions of the body were affected simultaneously with those of the neck, in 141 cases of "tumid scrofulous glands," as observed by Dr. Balman of Liverpool.*

	Per cent.		Per cent.
The neck only	in 83·69	The neck and inguinal regions .	4·26
The neck and axilla . . .	6·38	The neck and poplitial space .	·70

The neck and above the bend of the elbow, 4·97 per cent.

B.—TUBERCULOSIS IN ANIMALS.

Tubercles have been found in almost all classes of animals; in both herbivorous and carnivorous mammalia, in birds, reptiles, and probably in insects. In many of these it is the most frequent anatomical element of disease. (Sir J. Clarke, on Consumption, p. 212.)

In the *mammalia*, tubercle is distinguished from pus by the absence of the pus globule and the presence of the same microscopical elements as in man (p. 119). It has frequently a grey colour, sometimes the tint of chamois leather. As in man, the central softening is never attended with the formation of pus corpuscles, and cannot be attributed to inflammation; the peripheral softening is usually attended with inflammation of the surrounding tissues being almost always mixed with pus globules. As in man, also,

* Researches and Observations on Scrofulous Disease of the External Lymphatic Glands, 1852, p. 14.

so in animals, cretaceous concretions are sometimes the remains of small deposits of pus, but this is generally of the "scrofulous" variety, and calcareous concretions occur in the lungs having the same chemical composition, and are the last modification of tubercle.

Tubercles have been met with in the *lion, dromedary, antelope, deer, horse, cow, sheep, goat, pig, guinea pig, hare, rabbit, squirrel,* and *porpoise.* Mr. Owen found tuberculous disease after death in the following animals—tenants of the gardens of the Zoological Society—the *Persian lynx; tiger; paradoxure gennet; civet cat; Indian ichneumon; brown coati mondi; Nepál bear of the Himalaya mountains; American tapir; American elk; ourang outang; Macaque monkey; bonnetted monkey; pig-tailed monkey; green monkey; Mandrill baboon; black-fronted lemur; ruffed macauco; Esquimaux dog.* (Sir J. Clark, lib. cit., p. 212.) It is rare in the solipedæ and still more rare in the carnivoræ under domestication; the domestic dog and horse are much less subject to it than to cancer, whereas nearly all the monkeys brought to this country die of tuberculosis.

As in man, the lungs, lymphatic glands, spleen, mucous membrane of the intestines and liver are the organs most frequently affected. The lungs are sometimes almost entirely cemented with tubercular matter; sometimes the lungs only, sometimes many organs are affected. In the monkey, M. Reynaud (Archives Générales de Med., t. xxv,) found the larynx ulcerated; the bronchial glands always more or less tubercular; in one instance they compressed and obliterated the left bronchus, so as to produce contraction and prevent respiration in the corresponding lung; the spleen enlarged. Tubercular points were found in the blood of the cells of the spleen, and in one case the tubercles in the lungs were isolated and crude, while those in the spleen were large and softened in the centre.

Pathological conditions of the bones are found in tubercular monkeys, and especially in those of America, and they appear to be analogous to the softening and other affections of bones which occur in tuberculous children. Similar affections are found in the bones of carnivoræ taken from warm latitudes to Paris.* The long and spongy bones of diseased rabbits become tumid and softer.

Although tuberculosis is rare in the dog, pneumonia is frequent,

* M. Rayer, Comptes Rendus, July 18, 1842.

but in the calf, cow, and ass, the deposit of tubercle is almost always associated with chronic and progressive pneumonia.

Vegetable mould is sometimes found with diseased pleuræ in animals.

Tubercles in animals, according to M. Rayer, (lib. cit.) may be easily distinguished from the yellow matter found in the hydatid cysts of the ruminantia, from purulent matter undergoing successive transformations as in the horse, from verminous lungs, and also from some deposits peculiar to glanders which differ from true tubercular matter. In the ruminantia tubercle is often associated with vesicular worms; and in particular with the echinococcus; but there is no necessary connection, or sequence, or transformation of hydatids into tubercle.

In the Cetacea.—M. Bénard, of Caen, examined the body of a female porpoise cast ashore on the coast of Brittany. The left lung was almost completely filled with tubercles, the pulmonary texture having almost entirely disappeared. There were numerous firm pleuritic adhesions on the same side. The opposite lung was sound, and there was no trace of tubercle in any of the other organs. The adipose tissue generally was scanty and of a yellowish tint.*

In *birds* tubercular matter is less distinctly characterized than in mammalia; pus itself is less distinctive. Nevertheless a dry, yellowish substance, free from pus globules, the physical characters resembling those of tubercle in the mammalia is met with, and the occurrence of tuberculosis in some birds brought from warm climates to London and Paris is so frequent as almost to exclude all other diseases. This is the case with *parrots,* under whose bills scrofulous tumours are often seen. It is met with also in the *flamingo, turkey, house sparrow,* and *domestic fowl;* in the latter the bones are sometimes softened, spongy, sanguineous, fragile, and the medulla contains a reddish serosity. In some birds, however, the disease is said to be rare, especially the rapacious ones.

In *reptiles* and *fishes* tubercle occurs, but it is less distinctive than in birds.

In *insects.*—From Sir J. Clark's work (p. 214), I learn that Mr. Newport found in the larva of the *sphinx lagustri,* and other insects, a peculiar matter, which is probably tubercular. It occurs disseminated in small, irregular, aggregated masses, white, opaque,

* Revue Médicale, Jan. 1845.

and of a cheesy consistence, over the whole internal surface of the insect, between layers of very delicate areolar (cellular) tissue. They were most numerous among the muscles; on the exterior of the alimentary canal, particularly the stomach; on the secretory, silk glands; in the biliary ducts; and on the nerves. They were found also of smaller but more uniform size in the cellular and pulmonary tissues of the ground beetle and *stapylinus olens*, both carnivorous feeders. The sphinx had been fed upon *stale* leaves of the privet for some days previously to examination, the unusual wetness of the season having prevented a fresh supply.

Mr. Newport, in a subsequent communication to Sir James Clark, states that the concrete matter, which he believes to be tubercular, is deposited chiefly between the layers of cellular tissue throughout the whole body of the insect. The skin of the diseased insect (if in the state of larva) is generally slightly discoloured, dry and shrivelled; and the insects are deficient in the plumpness of healthy individuals. In the *oil beetle (meloë cicatricosus*, Lin.), a vegetable feeder, similar tubercular masses existed upon the alimentary canal, hepatic vessels, and within the trachea; and there was one large mass much softer than the others within the substance of the right supra-œsophageal ganglion or brain, occupying at least one-third of the ganglion itself.

In the *crustacea*.—In the common shrimp collected from their natural haunts, Mr. Newport found the disease was more common than in insects; the matter being disseminated in small granulated masses through the whole body, even within the substance of the nervous columns. Similar granulations were also found in the common craw-fish.

C.—TUBERCULOSIS IN VEGETABLES.

The existence in plants of organic cells developed in a fluid blastema, and of tissues and organs dependent upon cell-growth, analogous to the structures which constitute the animal fabric, would lead us *à priori* to the conclusion, that a disease of nutrition analogous to the tuberculosis of animals might occur in plants. Observation demonstrates, that under certain influences plants more or less rapidly lose their natural colour; their tissues become soft and blanched; the circulation of the sap becomes languid; the growth slow and stunted; or excessive and irregular; the trunk becomes crooked, deformed, and full of

knots; the bark dry, uneven, and covered with parasites; and they exhibit every indication of a deficiency of vital power. (Lepelletier.) All these symptoms have their analogues in the tuberculous constitution of animals, as described in the first and second chapters of this work, and so close is the resemblance that the mind is at once impressed with the notion that they may own an identical efficient cause. This notion is very greatly strengthened by a general fact which will develope itself in a future chapter—that many of the causes which are most operative in accelerating the development of, or aggravating, and in truth inducing tuberculosis in animals, are precisely the same as those which produce in plants the condition here described. The pathological anatomy of plants is a subject which, as far as I am aware, has not yet received serious consideration, yet it is well deserving of scientific investigation. My own observation leads me to believe that the diseases of man, particularly those involving modifications of nutrition, will ultimately be elucidated by the study of the diseases of plants as well as those of the lower animals.

SECTION XIV.

GENERAL OBSERVATIONS AND DEDUCTIONS FROM THE FACTS DEVELOPED IN THE SPECIAL PATHOLOGICAL ANATOMY OF TUBERCULOSIS.

Although the greater number of the details contained in preceding sections are more directly applicable to the individual varieties of tuberculosis, they have to be regarded as a whole in reference to the diseased condition of the blood. If the anatomico-pathological facts were not associated and generalized they would be liable to mislead, and in fact, erroneous views on the nature and causes of the disease have frequently been founded on a partial knowledge of the pathology. Independently of this, and notwithstanding the deficiencies in the statistics of the subject, by attention to the facts revealed by *post mortem* examinations, pathologists have arrived at some highly important, practical, general conclusions.

1. *Loss of weight,* as a symptom of tuberculosis has been fully described in the second chapter, and it is there stated generally that for the most part the viscera do not participate in it. The loss of weight of the body as a whole being estimated at an average of 48 pounds, or about one-third of the weight of the in-

TABLE VI.

Post mortem average weight in ounces avoirdupoise of each organ, and the sum of the weight of all the principal organs, in the Pulmonary Variety of Tuberculosis in the adult. Collated from Dr. Boyd's papers. (Lib. cit.) *Also the weight adopted as the standard of health by Dr. Clendenning.*

	Average Weight.	MALES. No. of Cases.
From 17 to 60 years of age.		
Brain (Cerebrum / Cerebellum / Medulla) 70 cases (40·64 / 4·92 / ·9)	46·34	88
Heart	9·81	91
Lungs (Right Lung, 79 Males, 37·11 / Left Lung, 78 Males, 35·1)	72·21	79
Liver	54·63	90
Spleen	7·	91
Stomach	5·	88
Pancreas	3·	87
Kidneys	11·1	91
Renal Capsules	·5	30
Ozs.	209·59	
From 60 years upwards.		
Brain (Cerebrum / Cerebellum / Medulla) 16 cases (34·5 / 5· / ·98)	46·13	20
Heart	10·84	21
Lungs (Right Lung, 20 cases, 33·21 / Left Lung, 20 cases, 31·)	64·21	20
Liver	44·98	20
Spleen	4·32	21
Stomach	5.25	21
Pancreas	2·94	21
Kidneys	9·	21
Renal Capsules	·51	16
Ozs.	188·10	

	Average Weight.	FEMALES. No. of Cases.	Standard of Health. M.	Standard of Health. F.
Brain (Cerebrum / Cerebellum / Medulla) 38 cases (37·27 / 4·67 / ·83)	42·5	48	45·5	42·
Heart	8·53	50	9·	8·125
Lungs (Right Lung, 39 cases, 25·98 / Left Lung, 39 cases, 24·)	49·98	39	46·5	35·5
Liver	51·82	49	49·	44·5
Spleen	5·94	49	4·75	4·5
Stomach	5·	49	4·5	4.4
Pancreas	2·86	47	2·25	2·25
Kidneys	9·69	47	8·33	8·
Renal Capsules	·5	26	·5?	·5?
Uterus	1·26	15		1·26?
Ozs.	178·08	Ozs.	170·33	151·035
Brain (Cerebrum / Cerebellum / Medulla) 9 cases (35·57 / 4·36 / ·8)	41·	15		
Heart	7·4	13		
Lungs (Right Lung, 14 cases, 23·71 / Left Lung, 13 cases, 20·23)	43·94	13½		
Liver	41·42	14		
Spleen	4·5	15		
Stomach	4·51	15		
Pancreas	2·	15		
Kidneys	7·	15		
Renal Capsules	·5	15		
Uterus	1·26	15		
Ozs.	153·53			

dividual in a physiological state (p. 74), and this being taken as the measure of the emaciation, the principal viscera have been found to be increased in weight, as indicated by the following table:—

The loss of weight of the whole body in phthisis is shewn by the following averages :—

	lbs.
Mean weight of 141 adult male paupers, weighed by Mr. Hutchinson at the Marylebone Workhouse . . .	134·
Mean weight of 103 adult male phthisical subjects . .	90·25
Mean weight of 64 adult female phthisical subjects . .	78·

The following appears to confirm the observation, that tall persons are most liable to consumption :—

The mean height of 141 adult male paupers was a little more than	5 ft. 3 in.
The mean height of 108 adult male phthisical subjects	5 ft. 7 in.
The mean height of 73 adult female phthiscal subjects	5 ft. 2 in.

The mean height of the male consumptive patient was thus nearly 4 inches more and their weight nearly one-third less.

2. Very serious errors would result from vague conclusions as to *the relative frequency of tubercles in the different organs,* and here it is the numerical method only that can be relied on. It is much to be regretted that the registration of the post mortem appearances is not more complete, and is not conducted upon a generally understood uniform plan in the various institutions of a country and even in different countries. It is also much to be regretted that we have not the means of comparing the pathological facts discovered in a large number of cases registered in London, for instance, with an equal number registered in country hospitals ; or those observed in London with those observed in Paris. We have no right to assume that cases of tuberculosis pulmonalis, for instance, observed at the Marylebone Infirmary, in London, should afford the same numerical results as cases observed at the Hotel Dieu, but we cannot determine the fact without a comparison of statistical tables on a very large scale. The statistics before us are extremely limited and for the purpose of comparison I have framed them all into a single table. I will only further remark, that because M. Lombard found tubercles in the mesentery in 19 per cent. of 100 cases of phthisis in Paris, and Dr. Boyd a little more than 3 per cent. of 179 cases in London, we cannot infer that the mesenteric complication is, as a general rule, more frequent in the former than the latter place ; although, if it were a proved fact by statistical data on a sufficiently large scale, it would be one of immense importance in investigating the etiology of local diseases in tuberculous subjects.

TABLE VII.

The frequency of the Development of Tubercles in the various organs of the body, in 1136 *cases of Tuberculosis occurring at all ages. It shews also the relative frequency in each organ in adults and children chiefly under* 15 *years of age.*

Organs affected.	In 350 adults. Louis.*	In 100 adults. Lombard.†	In 197 adults. Dr Boyd.	In 312 children under 15 years. Rilliett and Barthez.	In 100 children. Lombard.	In 50 children. Papavoine.	In 27 children und. 11 Dr. Boyd.	Total in 647 Adults.	Total in 489 Children.	General Total in 1136 cases.
The Lungs	348?	100?	179	265	73	38	27	627?	403	1030
„ Small Intestines	116	26	36	134	11	12	5	216	231	447
„ Great Intestines	38			60		9				
„ Lymphatic Glands—*a* of Mesentery	87	19	6	144	31	25	14	112	214	326
b Bronchial	...	9	3	249	37	49	8	12	393	405
c Lumbar	29	4	...	...	1	...	...	33	1	34
d Cervical	35	7	...	...	7	26	...	42	33	75
h Gastro-hepatic	...	...	...	...	5	...	...	...	5	5
i Inguinal	...	...	...	...	3	...	...	...	3	3
k Axillary	...	3	...	...	...	...	...	3	...	3
l Anterior mediastinum	...	3	...	...	...	...	...	3	...	3
m Posterior mediastinum	...	1	...	...	...	...	...	1	...	1
„ Pleuræ	...	1	...	109	2	17	...	1	128	129
„ Peritoneum	...	4	5	86	5	9	3	9	103	112
„ „ Omentum	...	1	...	...	1	...	...	1	1	2
„ Pericardium and Heart	...	...	...	10	...	3	...	...	13	13
„ Nervous Centres—*a* Cerebrum	1	2	1	37	9	5	3			
b Cerebellum	1					3	...			
c Medulla Oblongata	...	1						10	118	128
d Spinal cord	...	2	...	...	...	...	...			
e Membranes of Brain	...	2	...	52	6	3	...			
„ Spleen	25	6	...	107	25	20	7	31	159	190
„ Liver	...	1	4	71	...	14	4	5	89	94
„ „ Parietes of the Gall Bladder	...	1	...	...	1	...	...	1	1	2
„ Stomach	...	...	...	21	...	1	...	...	22	22
„ Pancreas	...	...	...	...	5	1	...	...	6	6
„ Urinary Organs—*a* The Kidneys	8	1	3	49	11	2	2	12	64	76
b „ Suprarenal Capsule	...	...	1	...	...	...	...	1	...	1
„ Ureters	1	1	...	...	...	...	...	2	...	2
„ Bladder	...	1	...	...	1	...	...	1	1	2
„ Organs of Generation—*a* The Prostate Gland	27	1	...	...	...	...	...	28	...	28
b „ Uterus	1	...	1	...	...	...	...	2	...	2
c „ Ovaries	17	2	...	...	...	...	...	19	...	19
d Vesiculæ seminalis	...	1	...	...	...	...	...	1	...	1
„ Bones—*a* The Ribs	...	1	...	...	...	...	...	1	...	1
b „ Radius	...	...	...	...	...	1	...	...	1	1
c „ Vertebræ	...	1	...	...	...	1	...	1	1	2
d „ Tibia	...	...	...	...	...	1	...	...	1	1
„ Muscles—*a* Intercostal	...	...	...	...	...	...	...	2	...	2
False Membranes—*a* Of the Pleura	...	2	...	...	1	...	...	2	1	3
b „ Peritoneum	...	2	...	...	...	...	...	2	...	2
Thymus Gland	...	...	...	...	...	...	1	...	1	1

The manifest defects of these statistics must strike the attention at once. Tubercles in the bones are not noticed by Louis or Rilliett and Barthez, and tubercle in the testis does not appear in either column. In order to render such a table really useful, it should comprise at least 10,000 cases derived both from medical and surgical practice; the results would then form a numerical basis upon which we might satisfactorily found our reasonings upon some important points in the general pathology; as it is, it affords for the most part only approximative data.

* Andral's Path. Anat., by Townsend and West, vol. i, p. 522. † Idem.

3. Louis was at one time disposed to lay it down as a law that *after the age of fifteen years tubercles are not developed in any organ, without occurring also in the lungs.* As a general rule this is strictly true and highly important. If it had proved to be a law of nature, that is to say, having no exceptions, it would, to a great extent, have established the seat of the original production of tubercle to be the lungs. But numerous exceptions occur. Louis met with two in the class of cases which his work comprises, and refers to a third in the second edition. The preceding pages record that in the adult the morbid deposit is met with occasionally in various internal organs, and in the bones frequently, without being present in the lungs. Cases of external tubercular deposit without any internal organ being affected, both in adults and children, are also numerous, and the frequency of internal tubercular disease without any affection of the lungs in children may be inferred by the following table, drawn up by MM. Rilliett and Barthez:—

Number of cases in which the various organs were tubercular without the lungs being affected in 312 tuberculous children.

The bronchial glands	19	times.
„ pleura.	2	„
„ brain	2	„
„ membranes of the brain	1	„
„ kidneys	1	„
„ bronchial glands and brain	4	„
„ „ pleura	2	„
„ „ spleen	1	„
„ bronchial and mesenteric glands	3	„
„ mesenteric glands and digestive tube	1	„
„ brain and pleura	1	„
„ „ mesenteric glands	1	„
„ „ spleen	1	„
„ three or more organs	8	„
	47	„

Papavoine also found the lungs exempt from tubercle twelve times in 50 young tuberculous subjects.

4. Louis further pointed out the general rule that tubercle being deposited simultaneously in the lungs and other organs is in a state of more complete development in the former. But in adults numerous exceptions to this occur, and it is very far indeed from holding good in children.

MM. Rilliett and Barthez maintain that in more than half the

infants affected with tubercles in the lungs the tuberculization in these organs is a secondary affection, and especially so in the younger subjects; while from 11 to 15 years this is a much less frequent circumstance. In other infants the tuberculization of the lungs is very abundant, and evidently the principal disease, and the cause of death; the proportion becoming greater from 6 to 15, and especially from 10 to 15 years of age. In about a fourth part of the cases the pulmonary affection, although intense, was not of itself sufficient to be the immediate cause of death.

5. Louis also thought that where tubercles exist in various other parts of the system besides the lungs, they present a similar degree of development in all these parts. This is undoubtedly observed very frequently, but numerous exceptions occur; a very variable degree of development is observed in the intestines, mesenteric glands, and bronchial glands in many cases; also in different parts of the urinary apparatus, and in other organs and tissues.

6. The *preferences* which tubercle exhibits for particular parts of organs wherein it is deposited, is a subject which deserves attention, and may assist in the rationale of the disease. In the lungs the preference is to the summit; in the brain, to the cortical part; in the membranes of the brain, to the pia mater at the base, and especially to the fissure of Sylvius; in the intestines, to the lower part of the ileum; in the osseous system, to the cancellated structure; in the female sexual organs, to the Fallopian tubes and fundus of the uterus; in the testicle, to the epididymis.—(Simon, Lect. on Path.)

7. The *post mortem* appearances presented after death from tuberculosis differ in *children* as compared with *adults* in several important particulars.

In a majority of cases in the adult it is found after death that a single organ, and that always the same, the lungs, is highly tubercular, the other organs containing none or a very few tubercles; but in children a single organ was tubercular in 48 cases only out of 312; and of these 48 cases the lungs were not even the organ affected in a majority, as will be seen by the following enumeration:—

The lungs	23	The brain	2
„ bronchial glands	19	„ meninges	1
„ pleura	2	„ kidneys	1

In 67 of these 312 cases also a single organ was very tubercular, the others containing but a few tubercles as follows:—

The lungs in	18
„ bronchial glands	12
„ brain	9
„ pleura	7
„ small intestines	7
„ mesenteric glands	3
„ peritoneum	3
The membranes of the brain in	2
„ spleen	2
„ stomach	1
„ large intestines	1
„ liver	1
„ kidneys	1
„ pericardium and heart	0

The following tabular view represents the number of cases in 312 tuberculous children in which two or more organs were found highly tubercular:—

The lungs and bronchial glands in	27
„ lungs and small intestine	27
„ bronchial glands and small intestine	17
„ bronchial glands and spleen	13
„ bronchial and mesenteric glands	11
„ bronchial glands and pleura	10
„ mesenteric glands and small intestine	10
„ liver and spleen	10
„ lung and spleen	8
„ bronchial glands and peritoneum	8
„ lungs and membranes of the brain	7
„ lungs and mesenteric glands	7
„ bronchial glands and liver	7
„ small intestine and large intestine	7
„ lungs and liver	6
„ small intestine and peritoneum	6
„ lungs and pleura	5
„ lungs and large intestine	5
„ small intestine and spleen	5
„ spleen and peritoneum	5
„ bronchial glands and membranes of the brain	
„ bronchial glands and large intestine	4
„ pleura and small intestine	4
„ small intestine and liver	4
„ lungs and peritoneum	3
„ pleura and mesenteric glands	3
„ pleura and spleen	3
„ small intestine and kidneys	8
„ large intestine and peritoneum	3
„ mesenteric glands and peritoneum	3
„ liver and peritoneum	3
„ lungs and brain	2
„ lungs and kidneys	2
„ bronchial glands and kidneys	2
The pleura and large intestine in	2
„ pleura and liver	2
„ pleura and peritoneum	2
„ membranes of the brain and brain	2
„ membranes of the brain and spleen	2
„ mesenteric glands and liver	2
„ mesenteric glands and kidneys	2
„ lungs and pericardium	1
„ lungs and stomach	1
„ bronchial glands and brain	1
„ bronchial glands and pericardium	1
„ bronchial glands and stomach	1
„ pleura and membranes of the brain	1
„ pleura and kidneys	1
„ membranes of the brain and pericardium	1
„ membranes of the brain and small intestine	1
„ membranes of the brain and large intestine	1
„ membranes of the brain and liver	1
„ membranes of the brain and peritoneum	1
„ brain and large intestine	1
„ brain and spleen	1
„ brain and peritoneum	1
„ stomach and small intestine	1
„ stomach and spleen	1
„ large intestines and mesenteric glands	1
„ large intestine and kidneys	1
„ mesenteric glands with peritoneum	1
„ liver with kidneys	1
„ spleen with kidneys	1

In 48 cases two organs were very tubercular, the others containing only a small quantity; in 29 cases three organs; in 11 cases four organs. In 95 cases many organs, from 8 to 12, were highly tubercular; and, in one instance, 13 organs contained tubercle. In 51 cases they were very numerous, *exclusively* in the chest; in 36 cases in the abdomen; in 11 cases in the encephalon; and in two cases in the abdomen and encephalon exclusively of the chest.

Without enumerating some minor points of difference the pathological facts shew that—

1. Tubercles occur in other organs without there being any in the lungs much more frequently in children than in adults. 2. They are deposited in a greater number of organs in the same individual. 3. The organs most frequently affected are not the same in children and adults. The occurrence of tubercles in the glands generally, and in the bronchial glands in particular, in the nervous centres, the spleen and the liver, are much more frequent in children. 4. Grey granulations and crude miliary tubercles exist alone more frequently in children than in adults. 5. Tubercles are frequently in an advanced stage of development, with softening and suppuration in the bronchial glands and other organs, being still in a crude state in the lungs, which rarely occurs in the adult. 6. The form of yellow infiltration is much more frequent. 7. The transition from grey transparent granulation to crude yellow tubercle takes place much more quickly.—(Papavoine.) 8. The products and signs of inflammation,—of the parenchyma, of the lungs, and of the bronchial tubes—are more frequently met with, and when met with, are more generally diffused. Disseminated lobular pneumonia occurs to a greater extent in children, and most frequently explains the rapidity of the fatal result. 9. Cavities are much less frequent in children than in adults, the tubercles in the former remaining at the period of death in a state of crudity. 10. Vacuoles, or very small cavities, produced by the softening of small tubercles, sometimes very numerous, are peculiar to the lungs of children. 11. A fatty condition of the liver is a rare occurrence in very young infants. 12. The older children are, the less marked as a whole are the above distinctions, and the more closely the pathological appearances resemble those which are observed in the adult. 13. The local development of tuberculosis in children, particularly while very young, resembles the local development as it occurs in the acute much more closely than in the chronic tuberculosis of adults.

8. *In advanced age,* also, the pathological appearances differ in persons who have been affected with tubercle as compared with early and adult age. 1. The tubercles occupy a more limited space at the summit of a lung than in children and adults. 2. They more frequently occur in the lungs alone, being rarely found in the bronchial glands, mucous or serous membranes or other organs; and they occur much more frequently in one lung alone. 3. They are met with in a state of crudity, softening, or suppuration, with cavities to a limited extent. 4. Hard, resistent, grey tubercles in the midst of a dull white indurated pulmonary tissue are more frequent. 5. Those appearances which are regarded as *cicatrized tubercular cavities,* or the *ancient traces of tubercles,* are much more frequently met with in old than in younger persons.

Much difference of opinion exists with respect to the last-mentioned appearances in the lungs of persons who die in the middle and after periods of life. As M. Cruveilhier describes them, they consist of:—1. A puckering or shrivelling, with white or black induration of the lung. 2. Slate-coloured melanotic induration. 3. Cysts. 4. Distinct melanotic tubercle which has replaced proper tubercular matter. 5. Caverns. 6. Several of the above appearances combined, to which may be added—7. Cretaceous concretions.—(Lib. cit., liv. xxxij, p. 5.) These appearances present themselves as well where there is no evidence of the individual having exhibited the signs of tuberculosis pulmonalis during life, as where, on diligent enquiry, more or less certain or presumptive evidence may be obtained of tuberculosis having pre-existed.

Of 160 individuals who died in La Salpêtrière, M. Beau * found cicatrices in one or both lungs in 157; they generally occupied the summits of both lungs. In the bodies of those who had died in the middle and after periods of life cretaceous masses or tubercles, most frequently free from any evidence of recent morbid action, were found in the lungs:—

By M. Rogée†	in	51	cases out of	100
„ M. Boudet‡ (from 15 to 76 years of age)	„	61	„	116
„ Dr. Hughes Bennett, of Edinburgh§ .	„	16	„	73
„ M. Beau, as above	„	157	„	160
		285		449

* Etudes Chimiques sur les Maladies des viellards—Journ. de Méd., p. 336.

† Arch. Génér., iii. s. to v, p. 191. ‡ Compts. Rendus, t. xvi, p. 143.

§ Ed. Med. and Surg. Journal, April, 1845.

There can be no doubt that in many of these cases the blood had been tuberculous at some period of life, and that tubercles in the lungs had been produced—the anatomical element of pulmonary phthisis without the production of phthisis;—but it may be, as remarked by Dr. Blakiston, that it is not every cretaceous particle or fibrinous nodule which must be taken to represent the pre-existence of tubercle; if they were to be so regarded the above facts would indicate that a tuberculous transformation of the blood is very easily and very frequently acquired, and also easily and frequently recovered from. As it is, the facts strongly corroborate the opinion, that tuberculosis is much more frequently cured than had hitherto been believed.

9. A careful consideration of the pathological details contained in this chapter leaves no doubt that, as respects the pathological anatomy, tuberculous and scrofulous affections are essentially of the same nature. Cutaneous, glandular, bronchial, pulmonary, intestinal and osseous inflammation, suppuration and ulceration, are specifically the same in either form of the disease.

The *relative frequency* of the more important local manifestations of tuberculosis in the form of "*scrofula,*" is illustrated by M. Lebert from 537 patients. Of these cases, 351 presented at the same time more than one local affection. Of the 186 cases in which at the time of observation there was but one form of the disease, many had previously had other scrofulous affections; or they presented the same form in several localities; thus, several articulations or several bones at a distance from each other, were simultaneously diseased. (Lib. cit., p. 57.)

The site of local disease in 537 tuberculous patients:—

	Males.	Females.	Total.
1. Diseases of the bones	159	143	302
2. Ophthalmias	73	89	162
3. Abscesses and ulcerations	77	63	140
4. Diseases of the joints	71	48	119
5. Diseases of the skin	44	72	116
	424	415	839

The site of local disease in the 186 cases in which one form only occurred:—

	Males.	Females.	Total.
1. The bones alone diseased	55 +	51 =	106
2. The eyes alone	10 +	11 =	21
3. The subcutaneous cellular tissue . .	8 +	7 =	15
4. The joints alone	18 +	10 =	28
5. The skin alone	5 +	11 =	16
	96 +	90 =	186

The subjects of scrofula in the highest degree are not necessarily affected with tuberculosis pulmonalis, or with any other variety of internal tuberculization, but the deposit of tubercle is one of the most frequent results. The transition of one disease into the other, and the general association of the pathological products of both, are well illustrated by M. Hérard, (Arch. Général), who found, on the post mortem examination of *fifty* individuals dying of affections denominated "scrofula," that *forty* had tubercle in the internal organs. In a series of cases of scrofula which, for the most part, are not fatal in their issue, but include opthalmias, glandular affections, skin diseases, and the like, the blood of a large proportion is matured for the production of tubercle, and the morbid element is actually deposited; thus Lebert estimated the existence of tubercle in 175 out of 614 cases of scrofula—(p. 230).

When tubercles are deposited from tuberculous blood both externally and internally, there is generally up to a certain point a direct relation in the abundance of the deposit; although, when external deposition proceeds rapidly, it tends to diminish the progress of the internal deposit; and when internal disease proceeds rapidly, it has a direct tendency to arrest the progress of external tuberculization;—thus, we frequently see tubercular external glands, which have been coeval in their origin with mesenteric disease, arrested in their development by the rapid progress of the disease in the mesentery and its extension to the lungs. The same principle is well illustrated by Lebert in the following statement of the relative frequency of suppuration in the external glands, when there is and when there is not a complication of the affection :—

In 67 cases of tubercular external glands	uncomplicated	41	suppurated
„ 74 „	complicated with scrofulous affections	37	„
„ 10 „	„ with phthisis . .	3	„
„ 10 „	„ with scrofula and phthisis	3	„

Thus when tubercular glands suppurate, complications with in-

ternal tuberculosis and other tubercular affections are observed much less frequently than when they do not suppurate.

10. Although at different epochs of life there are great differences in the relative frequency of the development of local tubercular disease, in the form which the disease assumes, and also in the seat of development, it would be an error to refer these circumstances to an essential difference in the nature of the blood disease, inasmuch as they are referrible to various causes, and are, to a great extent, satisfactorily explained by such causes, as—1. The progressive physiological modification of the blood, corresponding with which the pathological products of tuberculous blood are also modified. 2. The relative changes in the nutritive and functional activity of different organs and structures at the different epochs of life. 3. The relative differences in the exposure of individuals to the various exciting causes both of general and local disease at different periods of life.

11. The anatomico-pathological facts herein contained are my justification for classing together in this work as one species of disease the numerous affections hitherto divided into "tuberculous" and "scrofulous" diseases.

CHAPTER V.

OF THE CAUSES OF TUBERCULOSIS.

Volumes have been written on the causes of those diseases of which tuberculosis is the parent, and very little that is satisfactory can be elicited from them. Louis remarks that in relation to etiology, facts are wanting in regard to almost every question that may be started, and Lebert affirms, that we are entirely ignorant of the true causes of scrofula and tubercle. (Lib. cit. p. 54.) In treating of the causes, those which are concerned in the production of local disease in tuberculous subjects, as of the deposition of tubercles in the lungs, or of external abscesses and ulcerations, have been assiduously attended to, and the causes of these local affections have been strangely commingled with the causes of the general diseases. Sir James Clark made the distinction very clearly, but statistical writers have very little regarded it. For instance, we are put in possession of the mortality per cent of scrofula in a given locality, but a high mortality for scrofula may correspond with a low mortality for consumption and other varieties of tubercular disease, and a low per centage of tuberculosis in the aggregate. There may be fewer tuberculous subjects in one district than in another, but owing to the habits and occupations of the people leading, for instance, to exposure to the inclemencies of the weather or to accidents, there may be more deaths from scrofula; or perhaps, owing to sedentary habits and complicated misery, as in towns and manufactories, there may be more deaths from phthisis in that district where the general disease prevails less than in others. In almost all the statistics, and in the inferences deduced from them, it is omitted to be taken into account that of those who die of other diseases, as fever, accident, child-birth, and the like, a great proportion either are or have been tuberculous. Again, the statistics of phthisis, meningitis, mesenteric disease, and scrofula, have been too generally separated from each other, and sometimes combined with diseases of a totally different nature; hence great difficulty exists in arriving at any

general result. Statistical science will not effect all it is capable of in elucidating this subject until it embraces, in one category, all the forms of the disease. The object in the present chapter is to ascertain the causes of the constitutional disease, and it may be here stated, that those which can be shewn to possess any influence over its production in the individual are concerned in hæmatosis.

As we shall have to appeal to statistical facts in estimating the influence of various agencies in the production of this disease, it is important in the first instance to take a view of:—

The frequency of Tuberculosis.—I propose to limit the enquiry under this head to the frequency of the disease in this climate. The relative frequency in different countries will have to be considered under the head of the *geography* of the disease. Two modes of estimating the frequency, generally limited to particular forms, —as of phthisis—have been lately adopted. By the one, the mortality from the disease in proportion to the mortality from all other causes is taken; and by the other, the mortality in proportion to the number of individuals living—that is to say, of the whole population.

The object under this head is to obtain the broadest statistics. I accordingly first take *London*. The population in 1841, was 1,948,369, and in 1851, 2,361,640. Taking the year 1847—that of which I possess the fullest data on the subject generally—the population, estimated to the middle of the year, was 2,143,055; the deaths from phthisis alone 7010; the total number of deaths 60,442. Accordingly, the proportion of the deaths from phthisis to the deaths from all causes was 1 in 8·5; and the proportion to the population, or the number of individuals living, 1 in 305·7.

In the more recent reports of the Registrar General, scrofula, tabes mesenterica, phthisis, and hydrocephalus are classed together under the designation of "tubercular diseases," and in 284,438 deaths from all causes during five years, in London, it appears that 46,515 died of these diseases; or 1 in every 6·11 deaths from all causes; as shewn in the following:—

TABLE VIII.

The number of Deaths from Tubercular Diseases (four principal forms) in London, during the five years 1846 *to* 1850, *compared with the number of deaths from all causes. Shewing also the number of deaths quarterly in each year compared with the number of deaths quarterly from all causes.*

		QUARTERS ENDING: March		June		September		December		
Scrofula	1846	75		77		84		71		307
	1847	53		73		68		84		278
	1848	89	363	100	439	86	403	92	406	367 1611
	1849	74		112		85		83		354
	1850	72		77		80		76		305
Tabes Mesenterica	1846	139		202		343		177		861
	1847	192		227		306		265		990
	1848	233	920	199	997	250	1419	174	964	856 4300
	1849	198		196		282		165		841
	1850	158		173		238		183		752
Phthisis	1846	1571		1850		1784		1685		6890
	1847	1823		1733		1581		1873		7010
	1848	1873	8523	1699	8538	1534	7913	1450	7936	6556 32,910
	1849	1630		1708		1506		1473		6317
	1850	1626		1548		1508		1455		6137
Hydrocephalus	1846	488		443		448		342		1721
	1847	440		407		415		408		1670
	1848	390	2068	405	1958	351	1964	342	1704	1488 7694
	1849	380		383		393		314		1470
	1850	370		320		357		298		1345
Deaths from Tubercular Diseases			11,874		11,932		11,699		11,010	46,515
Deaths from all causes	1846	12,376		11,271		12,409		13,221		49,277
	1847	15,289		12,361		13,187		19,605		60,442
	1848	16,455		12,945		13,503		14,725		57,628
	1849	15,438		13,088		27,109		12,877		68,512
	1850	13,219		11,238		11,578		12,544		48,579
			72,777		60,903		77,786		72,972	284,438

The last summary of the London returns furnishes the following:

TABLE IX.

The mortality from Tuberculosis (four principal forms) in London during the year 1851, *the total population being* 2,373,799, *(estimated to the middle of the year) and the total mortality* 55,354.

	QUARTER ENDING: March 27th.	June 28th.	Sept. 27th.	Dec. 27th.	Total.
Scrofula	87	115	95	84	381
Tabes Mesenterica	175	190	251	196	812
Phthisis (or Consumption)	1792	1815	1683	1737	7027
Hydrocephalus	418	464	348	373	1603
	2472	2584	2377	2390	9823

This gives as nearly as possible one death from tuberculosis in every 5·6 of the deaths from all causes, and one in every 241·6 of the population. The mortality from phthisis alone is 1 in 7·8 of the whole mortality and 1 of every 337·8 of the population. The excess of mortality over previous years (Table VIII) is in phthisis and scrofula.

We will now take the whole of *England* from the same invaluable reports.

TABLE X.

The number of Deaths from Tuberculosis (four principal forms) in England during the year 1847, *compared with the number of deaths from all causes. Shewing also the relative number of deaths from Tuberculosis in the two sexes.*

	Males.	Females.	Total.	
Scrofula	1365	1039	2404	All Causes.
Tabes Mesenterica . .	2455	2125	4580	
Phthisis	25,083	28,234	53,317	Males. | Females.
Hydrocephalus . . .	4285	3378	7663	213,076 | 207,901
	33,188	34,776	67,964	420,977

This gives 1 in 6·2 as the proportion of deaths from *tuberculosis* to the deaths from all causes in England in 1847, and nearly 1 in 251·9 to the estimated population for that year.

As respects *phthisis*—the total number of deaths reported in 1847 for the whole of England is 53,317, or—according to corrections made for the increase of population to the middle of that year—one death to every 321·1 of the population; and the deaths from phthisis, 1 in 7·9; or nearly one in eight of the deaths from all causes.

Thus, the frequency of tuberculosis, and of its principal form—phthisis—in this country, estimated by the mortality at several recent epochs, may be represented approximatively as follows:—

	DEATHS.	LIVING.
Frequency of phthisis in London, 1847 . .	1 in 8·5	1 in 305·7
„ „ „ 1846, 47, 48, 49, 50.	1 in 8·6	variable
„ „ „ 1851 . . .	1 in 7·8	1 in 337·8
„ „ England, 1847 . . .	1 in 7·9	1 in 321·1
„ tuberculosis in London, 1847 . . .	1 in 6·1	1 in 215·4
„ „ „ 1851 . . .	1 in 5·6	1 in 241·6
„ „ England, 1847 . . .	1 in 6·2	1 in 251·9

The absolute frequency of tuberculosis is by no means determined by these statistics of the mortality of its most aggravated and fatal forms. In a great proportion of cases of all diseases no post mortem examination is made, and in some of these errors of diagnosis no doubt occur, or a tubercular state of the organs when complicated with other pathological states is overlooked, and there can be no doubt that a very large number of cases in which tuberculosis has existed are registered under other denominations. The assumption that all the cases of hydrocephalus are cases of tuber-

culosis undoubtedly leads to error in the direction of increasing the ratio of the mortality of tuberculosis.

But the main deficiency is in no data existing by which we can estimate the number of cases of tuberculosis which recover. The fatality from scrofula is comparatively very trifling. But the number of individuals affected at some period of their lives with the various forms of scrofula, who live to advanced age or die of other diseases, is very great indeed. It was shewn also in the last chapter (p. 364) that the number of individuals dying in advanced life, who afford evidence of having been affected at some previous period of their existence with internal tubercle, is probably also very great. When these circumstances are taken into consideration we are led to the conclusion that the mortality, even if we could determine it exactly, and enormous as it is, is no measure of the actual frequency of the disease; and that tuberculosis, regarded as a disease of the blood, occurs in a much larger proportion of the population than has yet been established upon any statistical data; in fact, if we assume that all the cases recorded are actually cases of tuberculosis, the sum total of the mortality represents the *minimum frequency of the disease.*

The increasing or decreasing frequency of tuberculosis or its *chronological history,* will come under consideration in a future section.

On a careful consideration of the whole subject of causation, it appears, that the specific morbid condition which constitutes tuberculosis can only result from hereditary transmission by the blood of one or both parents, or be produced by a modification of the blood of the individual. The causes of tuberculosis as we recognize them in practice are accordingly :—

I. *The hereditary transmission from parent to offspring of the predisposition to the disease or the disease itself.*

II. *The causes of the production of the disease in the individual.*

I propose to treat of these two totally different subjects in two divisions, but in order that their scope may be somewhat more fully before the reader at the outset, I may here state that the

causes which have been assigned of the original production of the disease in the individual admit also of a two-fold division into :—

1. *The causes of acquired tuberculosis in the embryo and fœtus.*
2. *The causes of acquired tuberculosis after birth.*

The latter are again divisible into :—

A. *The predisposing causes.*
B. *The inducing causes.*

This arrangement differs *in toto* from any that has been employed hitherto by those who have treated on the etiology of tubercular diseases. The reasons for adopting it will appear in the sequel.

DIVISION I.

THE HEREDITARY TRANSMISSION OF TUBERCULOSIS.

I limit the term "hereditary transmission" to its strict meaning, the transmission of the predisposition to a disease or of the disease itself, (which as respects tuberculosis is essentially the same thing), already existing in the parent, from the parent to the offspring. The question of hereditary transmission is one on which the widest differences of opinion have ever existed, and its elucidation, while of the deepest interest to mankind, is surrounded with innumerable difficulties.

The circumstances which render it so extremely difficult to arrive at a precise knowledge of the influence of hereditary transmission are: 1. Tuberculous patients, both those affected with tubercle and with scrofula, are frequently unwilling and more frequently unable to give a true history of their family health and mortality; and at the same time there is an absence of a complete and uniform system of registration in our public dispensaries and hospitals, which would constitute the only certain source by which such information could be supplied. 2. So large a proportion of the population is affected with a tuberculous state of the blood, and at the same time so large a proportion is subject to anti-hygienic influences, that in individual cases, and in masses of cases, it is very frequently difficult, and sometimes impossible to determine when the disease is transmitted hereditarily and when it has been acquired; a large proportion of the population being affected, a large proportion of the cases

may own tuberculous parents without the inference following that such cases have necessarily been transmitted; in innumerable cases, admitting the transmission, the offspring is also subject to the operation of those causes by which the disease may be originally induced; for instance, children are very frequently subject to the same anti-hygienic influences as their parents. In all such cases it is difficult to determine what proportion of the results is due *ab origine* to the one or the other cause. 3. The existence of special institutions which receive different forms of tuberculosis, and the wide separation from or confusion with other diseases, in all our registers, of such prominent forms as consumption, tuberculous affections of joints, tuberculous meningitis, tabes mesenterica, tuberculous disease of the os petrosum, and the like; the consequence of this separation of patients and diseases being a limitation of the enquiries which precede registration. An apposite illustration of the difficulty occurred in my own practice—a policeman was affected with phthisis, and purported to present no hereditary history, "there was no consumption in his family;" but on close investigation it turned out that his father died in a hospital, at an early age, of a diseased hip-joint, three children in the family died young of "water in the head," and one sister had scars on her neck from previous glandular disease.

These circumstances have to be applied in any inferences which may be drawn from published cases and statistics. At the same time it would be a great error to disregard these statistics, which, when properly drawn up, speak the truth as far they go. It is an error, for instance, to infer, of a number of cases presenting a complete history of hereditary transmission, the whole or a large proportion having also been subject to anti-hygienic causes of the disease, that the latter circumstance constitutes any proof that a transmission from parent to offspring did not take place.

That tuberculosis once acquired by the individual may be transmitted hereditarily, and that a proportion of the cases which occur are referrible to this origin, may be proved to demonstration. It is shewn by: 1. The frequency of the signs of the predisposition in the offspring of tuberculous parents. 2. The frequent occurrence of scrofula, phthisis, hydrocephalus, and other forms of the disease in the children of tuberculous parents, and the mortality exhibited by tuberculous families; instances occur where every individual

of a large family becomes affected, and the disease is handed down without interruption from one generation to another, and presents itself in the collateral branches of the same family. 3. The occasional occurrence of scrofula and tubercle in various structures and organs of the fœtus in utero; and in these instances, with scarcely any exception, one or both parents being tuberculous. 4. The hereditary transmission of the disease in animals; fully established by M. Duprey;*—in a flock of merinos a phthisical ram produced from 16 to 20 tuberculous sheep. (Delafond.) 5. Tuberculosis, as an active disease in various forms, is so frequently developed at an early age in the children of tuberculous parents, that no doubt can be entertained of its origin from the earliest period of utero-gestation. The body of an infant a few weeks or months old, the mother being in the last stage of phthisis when she gave birth to it, has been found in a state of extreme emaciation with an extensive display of tubercles, both miliary and crude yellow, pervading the whole of the lungs on both sides, the spleen, the mesentery, and the peritoneum, and exhibiting tuberculosis in its highest degree of intensity. (Scudamore.) Some writers state that there is no instance where the disease in its active form occurs in the very young infant, or in the fœtus in utero, without its having actually existed in the parent, and they consider that no negative evidence can be brought against these facts to invalidate the opinion that the disease may be hereditary. 6. It frequently happens, that a healthy man marries a tuberculous wife, and has tuberculous children; he subsequently marries a second wife who is not tuberculous, his children being free from tuberculosis; and the same proposition may be affirmed of a woman who marries two husbands, one tuberculous and the other non-tuberculous. The children in many instances are tuberculous whenever one of the parents are affected, and they are healthy when neither parent is affected. 7. The occurrence of the disease in families independently of any other agency to which it can be referred, and under circumstances of hygiene the best calculated to ensure robust health. 8. Statistical records are decidedly confirmatory of the hereditary transmission.

Among those who admit the fact of hereditary transmission great differences of opinion have existed as to the form in which it takes place. One class maintains, that a simple hereditary pro-

* Traité de l'affection Tuberculeuse chez les Animaux, Paris, 1817.

clivity to the disease—an undue vulnerability—is transmitted; another, that the germ, or the disease in its latent state; and a third, that the disease in its active form is transmitted. I believe that all these circumstances occur.* The facts detailed in the first and fourth chapters of this work and the above statements, establish this conclusively as respects the two latter. I consider the "proclivity" to the disease to mean simply the existence in the individual of one or more of the predisposing causes which will be described in a future section, and we shall presently see there can be no doubt that these constitutional causes also may be transmitted hereditarily.

(*a*) *The frequency of hereditary transmission.*—Some writers regarding the predisposition as something different from the disease deny the transmission of the latter, and admit that of the former; others deny hereditary transmission altogether; others adopting a very wide signification of the term maintain that the disease is always hereditary. (Lugol.) Others regard consumption and scrofula as two distinct diseases, and treat of them separately as respects this question. With these differences of opinion there can be no surprise that the statistics of the subject are limited and imperfect. Nevertheless it is statistical science alone that furnishes information to be relied on, and the tables on record are sufficient, not only to establish the fact of transmission, but perhaps to convey an approximative notion of its frequency.

M. Portal considered that two-thirds of his phthisical cases were derived from hereditary transmission. M. Piorry one-fourth. M. Ruysch four-fifths. M. Roche went so far as to affirm that the children of phthisical parents are in a manner consecrated to the disease. Louis, Briquet and Rufz, each analyzed a certain number of cases, and the following table contains the results:—

TABLE XI.

Cases.	Transmitted.	Acquired.	Doubtful.	
35	3	12	16	Louis.
90	36	53	6	Briquet.
35	24	6	..	Rufz.
156	63	71	22	

In the hospital for consumption at Brompton of 1010 phthisical

* Traité Philosoph. et Physiol. de l' Hérédite par Dr. P. Lucas, 1847.

patients 246 or 24.4 per cent. were born of phthisical parents. This is a very large per centage, and if it were made to include those whose grandparents and collateral relations were tainted, and also those who were born of parents and blood relations affected with other forms of tuberculosis, it would be enormously large.

MM. Rilliett and Barthez furnish the following interesting facts relating to the hereditary history of 525 children :—

TABLE XII.

	314 tuberculous children.	211 non-tuberculous children.
The father tuberculous	9	3
„ mother tuberculous	12	7
„ father and mother tuberculous . . .	4	2
„ father probably tuberculous	11	1
„ mother probably tuberculous . . .	10	3
„ parents probably or certainly non-tuberculous	138	95
„ information incomplete	130	100

In other terms, of 24 children whose fathers were tuberculous, or probably so, 20 died tuberculous and 4 non-tuberculous. Of 32 children whose mothers died tuberculous, or probably so, 22 died tuberculous and 10 non-tuberculous. Of 6 children whose fathers and mothers died tuberculous, 4 died tuberculous and 2 non-tuberculous. There were 46 cases, or about 1 in 7, in which the hereditary influence more or less prevailed, and 11 in which it was the sole probable cause.

Tables XI and XII consist of cases of tubercle. We next turn to the statistics of the prevalence of scrofula in a large number of children, with some particulars relating to their hereditary history as recorded by Mr. Phillips.

Of 2023 families, living nearly under similar circumstances, each consisting of 3 to 5 children—in all 7587 children—1738 of the children, averaging nearly 23 per cent., had marks of scrofula under the following circumstances relating to the parents.

TABLE XIII.

No. of Families		No. of Children	Do. with marks of Scrofula.
506	Both parents untainted . . .	2021	21 per cent.
276	„ „ with marks of scrofula	1092	25 „
589	Father with marks of scrofula .	2107	23 „
652	Mother with marks of scrofula .	2367	24 „

Mr. Phillips infers, from these results, that the maximum influence exerted by the hereditary transmission of "scrofula" from parent to offspring is not quite 4 per cent.; but it is to be observed, that he limits the marks of scrofula to enlarged glands, sinuses, or ulcerations resulting from them, and scrofulous bones or joints. It is quite evident that these 1738 children, under this limitation, form no criterion of the proportion affected with tuberculosis in the whole number of 7587; nor does the table convey any information of the proportion of the children of the tainted and untainted parents who may have died of tuberculous meningitis, or who were affected with tuberculous ophthalmia, or who might have been subsequently affected with internal tubercular deposit; but its greatest defect is, that it gives no account of the number of the parents of those children who had been or were at the time affected with other forms of tuberculosis, and more especially with consumption.

The statistics of tuberculosis pulmonalis or of scrofula constitute only a part of the statistics of tuberculosis regarded as a blood disease; two separate items of the statistics of the same disease—and these two forms are taken separately in the preceding tables. Lebert collected the particulars of the families of 132 individuals affected with *scrofula and tubercle,* and he found 87 of these families totally exempt, while 45 were either scrofulous or tuberculous. The following table exhibits some of the details of these cases.

TABLE XIV.

Tuberculous individuals . . .		No evidence of Hereditary taint in the families of 87 of the individuals affected distinguished as below.	Hereditary taint present in the FAMILIES of 45 of the individuals.			
			Scrofulous Families.	Tuberculous Families.	Scrofulous and Tuberculous Families.	
132 Individuals the subjects of Tuberculosis	44 Scrofulous . .	29	8	3	4	44
	30 Scrofulous and Tuberculous . . .	12	3	8	7	30
	58 Tuberculous . .	46	0	12	0	58
		87	11	23	11	132

From this table it appears that one-third of the cases of simple scrofula were the offspring of tuberculous subjects, the tubercu-

losis in the parent having presented itself in the form either of scrofula, tubercle, or both. Whereas about one-fifth only of the cases of simple tubercle were the offspring of tuberculous subjects —the tuberculosis in the parent having in every case appeared as tubercle. It appears also that where tuberculosis presents itself both in the form of scrofula and tubercle, the greater proportion of the cases have the history of hereditary transmission, viz., eighteen cases out of thirty, or $^3/_5$ths. Again, of 45 tuberculous families having tuberculous children, 34 of the families were *tuberculous* either with or without scrofula, and but 22 *scrofulous* either with or without tubercle.

Illustrative of the transmission hereditarily of scrofula from phthisical parents to their offspring, Dr. Balman of Liverpool carefully investigated the family history of 141 individuals affected with "scrofulous enlargement of the lymphatic glands," and found—

The father died phthisical of	9	
One or more deaths occurred from phthisis in the families (uncles and aunts) on the father's side, of	61	
Grandfathers on the father's side died of phthisis	11	
Grandmothers " " "	17	
	—	98
The mothers died phthisical of	11	
One or more deaths occurred from phthisis in the families (uncles and aunts) on the mother's side, of	38	
Grandfathers on the mother's side died of phthisis	9	
Grandmothers " " "	20	
	—	78
		176

In 30 of the 141 scrofulous individuals there were no deaths from consumption in either parents or collateral relations; but whether the latter had ever been affected with scrofula or exhibited any signs of the tuberculous constitution does not appear. In 60 instances consumption had occurred in one branch of the family only. In 40 instances in 2 branches. In 9 instances in 3. In 1 instance in 4. In 1 instance in 5 branches of the family.

Dr. Balman gives, together with these statistics, the details of individual cases which render them perfectly conclusive as to the fact of the hereditary transmission of the predisposition to scrofula by consumptive individuals.

Lugol also states that more than half the subjects of scrofula have consumptive progenitors; in a ward containing eighty-four

beds he constantly ascertained the existence of consumption in the one or other parent of more than half the patients.—(Lib. cit., p. 46.)

From these statistics, taking all the forms of tuberculosis which manifest themselves, it is little more than a conjecture to state, that perhaps, approximatively, about one-third of the cases derive their origin, in the individual, from hereditary transmission.

(*b*) *The relative frequency of transmission in the two sexes.*—A great difference of opinion has also existed on this point arising out of inferences drawn from too limited statistical data. Nasse maintained that hereditary transmission occurs only from the *mother* to her offspring. J. Frank refers it to the *father* more especially. M. Briquet gives 18 paternal transmissions to 11 by the mother. M. Roche thinks the father transmits the disease to daughters, and the mother to boys. Richard (de Nancy) also, as quoted by Mr. Phillips, thinks hereditary influence more certain when the father is diseased. He says—"I have rarely seen infants born of phthisical fathers escape disease of the lungs; and on looking over my notes, I see many cases of children proceeding from phthisical mothers, who have already passed the ordinary period of development of the disease."

In the Hospital at Brompton, of 246 cases born of phthisical parents the proportion of females was much greater than males;—viz., in the former, 36·3 per cent.; and in the latter, 18·2 per cent. After making allowance for the circumstance that probably daughters can give a more accurate account than sons can of the histories of their parents, it appears from this that daughters are more liable than sons to inherit phthisis from their parents nearly in the proportion of two to one.

The following table shows the consumptive blood-relations of these 246 cases—122 males and 124 females of the 1010 cases:—

TABLE XV.

Consumptive Blood-Relations.	Males.	Per cent in 669.	Females	Per cent in 341.
The father of	42	6·2	31	9·0
„ mother of	24	3·7	39	11·4
„ father and mother of	12	1·8	10	2·9
„ father, and brother or sister of . . .	21	3·1	16	4·8
„ mother, and brother or sister of . .	19	2·8	22	6·5
„ father and mother, and brother or sister .	4	·6	6	1·7

On the other hand MM. Rilliett and Barthez found in 314 chil-

dren that tuberculosis was transmitted nearly as frequently by one parent as the other. But inasmuch as females are somewhat more subject to the disease than males, as will be shewn in a future section, the inference drawn by them is, that the disease is transmitted to their offspring somewhat more readily by males than by females.

In Dr. Balman's 141 cases, assuming that all in whom the parents were affected in a direct line (parents and grandparents) were transmitted, it would appear that tuberculosis (the predisposition to scrofula) is more frequently inherited from the female line than the male line in the proportion of 48 to 29.

As respects the transmission of *consumption* by the 57 grandparents a contrary result was obtained:—

The grandfather transmitted it in	13	The grandmother transmitted it in	14
„ did not in	7	„ did not in	23
	20		37

Thus consumption was transmitted in a greater proportion by the male than by the female line.

(*c*) *The relative frequency of transmission by either parent to the two sexes.*—Another very important fact presents itself in table XV. Omitting those cases in which both parents were consumptive, the father is found to have transmitted the disease to the sons in 59·4 per cent., and to the daughters in only 43·5 per cent.; whereas, the mother transmitted it to the daughters in 56·5 per cent, and to the sons in only 40·6 per cent.; thus completely reversing M. Roche's opinion, as stated above, and appearing to establish, so far as these limited statistics go, that fathers affected with tuberculosis pulmonalis transmit the same disease to their sons more frequently than to their daughters, and mothers affected with the same disease transmit it more frequently to their daughters than to their sons. This inference is not altogether borne out by the table drawn from the records of the Consumption Hospital.

(*d*) *Transmission by the milk of a tuberculous nurse.*—From the time of Bordeau, Van Helmont, Wiseman, and Boœrrhaave to that of Lugol and other modern writers, an opinion has been very generally entertained that the milk of nurses affected with tuberculous diseases may produce tuberculosis (scrofula and consumption) in the child. White, Faure, and some others peremptorily deny it. It will be understood that the question here is totally

distinct from that of the influence of bad milk as defective or vitiated food, which will have to be considered in a future section. The writers I have quoted, and many others, have entertained a thorough conviction that phthisis and scrofula are communicated from wet-nurses to nurslings, the children of healthy parents, and themselves born healthy. Although many isolated cases in support of this view have been recorded, it must be admitted that we are in possession of no sufficient proof, either of the tuberculous qualities of the milk, or of the fact of the transmission of the disease through this channel from parent to offspring.

I am disposed, however, from observation and experience, and from the qualities of the milk of tuberculous subjects, to admit that a healthy infant may become tuberculous from being nourished with the milk of a tuberculous subject, as a sole cause: and that, by transmission from the blood of the nurse to the blood of the infant; but I believe it to be almost essential that the hygienic circumstances under which the child is placed should be unfavourable. Where a child originally healthy, but nourished upon milk derived from tuberculous blood, is placed under circumstances in other respects favourable to perfect hæmatosis, tuberculosis is very unlikely to be produced. Under these circumstances blood perfectly free from the tuberculous character will be produced in the child, and however defective this may be in nutritive qualities, unless some other causes coincide, the cell-growth and organization will not become tuberculous.

The observations frequently repeated by practical writers and confirmed by some of the statistics, that scrofula and tubercle are much less frequent during lactation and the first years of life than subsequently, if true, by no means invalidate the opinion that tuberculosis may be transmitted by the milk of the nurse as a sole cause. It is not that consumption or scrofula is produced, but a tuberculous condition of the blood, which may develope itself into these forms of disease at some subsequent period.

(*e*) *The hereditary transmission of the predisposing causes of Tuberculosis.*—Although the subject of the predisposing causes do not properly come under the present head, but belongs rather to that relating to the causes of acquired tuberculosis, it is necessary to refer to it here, inasmuch as it would be an error to conclude that the hereditary transmission of the specific morbid element the only hereditary influence exerted over the pro-

duction of the disease. There are physiological and pathological states which operate as predisposing causes of the disease, and will be described as such in a future section. These states may be transmitted hereditarily. The temperaments, for instance, are thus transmitted, and the lymphatic temperament has been regarded from the earliest times as a predisposing cause of tuberculosis. Anæmia and debility in the parent are frequently transmitted to the offspring. It has been shewn that tuberculosis is totally distinct from either anæmia or debility; "debility," moreover, as remarked by Baudelocque, is an indefinite term, and may either be a cause or one of the effects of a disease. It has already been described as a symptom of a tuberculous state of the blood (p. 81), and it will presently be described as a predisposing cause. Feebleness of constitution, however induced, is a predisposing cause of tuberculosis among many other diseases; the exciting or inducing causes of such diseases acting in general with greater force and certainty than in robust constitutions. While there can be no doubt of the transmission from parent to offspring of such a constitution, this must not be mistaken for the transmission of the disease itself.

(*f*) *General Remarks on hereditary transmission.*—Regarding tuberculosis as a disease of the blood and the constitutional origin of the different forms of phthisis and scrofula—having regard also to—1. The detailed description of the predisposition to the disease in the first chapter of the present work. 2. The anatomico-pathological results contained in the third chapter. 3. The above statistical data;—I draw the following inferences respecting its hereditary transmission:—

1. Accidental or acquired tuberculosis in the parent is transmitted to the offspring, either as a predisposition, or, in other words, as the germ of the disease in a latent state; or, as the disease itself in its manifest, active, patent, and characteristic state. The frequency of hereditary transmission cannot at present be determined by accurate data, but there is reason to believe that it is not so great as stated by some authors.

2. The hereditary transmission may take place either by the germ deposited by the one parent, or the spermatic fluid or fecundating material of the other, or by both; or it may arise during the nutrition of the germ from the yolk-bag even before the formation of the vascular area and the vessels with red blood; or it may proceed wholly from the blood of the mother during the

development of the fœtus in utero. Some of the most aggravated cases met with are referrible to both parents; a tuberculous germ, the materials of which have been furnished from the tuberculous blood of the mother, being fecundated from the tuberculous blood of the father, and again nourished and developed from the tuberculous blood of the mother.

3. Tuberculosis, whether acquired or received by hereditary transmission, is not *necessarily* transmitted from tuberculous parents to their offspring. The transmission depends upon the degree in which the blood is affected at the period of conception; and also, especially when the blood is slightly tainted, upon the condition of the blood of the opposite parent, and upon the hygienic circumstances under which the parents are placed, particularly the mother, during the whole period of utero-gestation. Hence the hereditary transmission of the disease, however inveterate this may be, is not permanent but, under favourable circumstances, it may become extinct in a few generations.

4. The minor degree or the earlier stage of a tuberculous state of the blood corresponding with the production of scrofula, appears to be altered for better or worse as the period of puberty advances; the blood in a great many cases becoming healthy, and in others, corresponding with the production of tubercle, confirmed in its metamorphosis. While scrofula, or rather the early stage of the blood disease, transmits an analogous condition of the blood, and the liability to scrofula, it rarely transmits tubercle, whereas the consummation of the disease of the blood corresponding with the deposit of tubercle very frequently transmits either tubercle or scrofula, or both.

5. For the transmission of the disease it is sufficient that one of the parents be tuberculous (p. 2), however robust the other parent; but, in proportion as the one is robust, particularly if it be the mother, so are the chances of transmission diminished. If tuberculous males had children by none but healthy or non-tuberculous females, and the causes of acquired tuberculosis could be done away with, the disease would soon become extinct in the human race. The effect would be considerable, but not so decided if tuberculous females had children by only healthy males.

6. It is a legitimate inference that the disease is hereditary if it be general in a family and have caused great mortality; or when one or other, or more of the parents in a direct line, have died

tuberculous, and the disease in the individual cannot be referred to anti-hygienic causes; but it is not essential that at the period of the conception of a child either parent should present the manifestation of disease internal or external. The only essential point is, that a tuberculous quality of the blood exists in the parent, however slight, or however latent this may be.

7. According to the extent to which the disease exists in the parent transmitting it, so as a general rule is the intensity of the disease in the offspring; but the operation of this rule must depend greatly upon the existence or non-existence of tuberculosis in the opposite sex. As already stated, the most intense and inveterate of the cases which depend upon transmission are those where both parents are tuberculous.

8. The evidence that tuberculosis is transmitted more frequently by the mother than by the father is strong, so far as limited statistical data go. Regarding it as a disease of the blood this result might have been predicated, since there is only one period at which the father's influence could be exercised, viz., that of conception; whereas, the influence of the mother is exercised at that period, and also throughout utero-gestation, and even throughout the period of lactation.

9. The children of tuberculous parents are very frequently subjected to all those causes which have concurred in the production of the disease in the parent. This circumstance has to be taken into the account in estimating the frequency of hereditary transmission, the numerical representation of which it tends to diminish, but it would be an error to assume that every individual born of tuberculous parents, and also subjected to anti-hygienic influences, is free from hereditary taint.

10. In individuals affected with tuberculosis who suffer from local disease in early life in the form of scrofula—as from suppurating lymphatic glands—and have been cured, the blood is not necessarily completely renovated and the disease eradicated. It very frequently happens—perhaps most frequently—that the pathological state of the blood is so far removed that during the life of the individual a repetition of the local manifestation of the disease never recurs in any of its local forms. But the blood may remain tuberculous to a sufficient extent to transmit the disease to the offspring. In this case, also, much depends upon the state of health of the parent of the opposite sex; if good, the result may be a

complete extinction of the disease in the first or second generation.

11. The cessation of the hereditary transmission of tuberculosis in a few generations has not been determined on statistical data, but individual and general observation admits it; assuming it to be a fact, it shews clearly that, however general the tuberculous constitution may be in the human race, it does not constitute a new species—universality and permanency of transmission being the type of specific distinction. This is also proved by the deterioration of the constitution pervading, not only the human species, but many other species in the range of organized nature. It is the more necessary to bear this in mind that no confusion may arise from tuberculosis being regarded as a distinct species of disease, (p. 2) a species in a nosological arrangement not being identical with a species in natural history.

12. The blood and organization of the fœtus may be tainted in so slight a degree that the latter may present no evidence of the disease at birth, and may live and grow without exhibiting any evidence even of the predisposition, in which case the morbid condition of the blood may be said to constitute no more than an hereditary proclivity to the disease; although not with logical accuracy. In this case the disease may remain latent for a long series of years, and the individual may escape its effects altogether unless subjected to the operation of influences capable of producing it originally, and therefore capable of aggravating the existing constitutional affection.

13. The hereditary transmission of tuberculosis sometimes corresponds with ancillary circumstances which will be enumerated as the origin of the predisposing causes of acquired tuberculosis; thus a child may inherit a feeble constitution from one parent and tuberculosis from the other. If hereditary transmission proceeds from one parent, any cause referrible to the other parent by which the constitution of the child is enfeebled, will increase the pernicious consequences of the tuberculous disease.

14. In a greater number of cases, where hereditary transmission has taken place, the blood and the organization are more intensely affected, so that the predisposition is exhibited in a more or less marked form from birth, and in this case the disease may develope itself in an active state without the co-operation of any other cause, or it may be produced with greater certainty and by less powerful

impressions from anti-hygienic influences than in those who are not hereditarily predisposed; and, although it is true, that in a great number of cases in which a predisposition to tuberculosis is transmitted hereditarily from the parent, the development of the disease requires the agency of external causes, yet in many cases, the action of the slightest cause in such a predisposition will give rise to the disease; and it too frequently occurs that, notwithstanding the absence of such causes, nothing will prevent the development of the disease. It is an error, therefore, to affirm that the hereditary tendency is a mere pathological susceptibility to an ultimate and indeterminate disease—although the disease is not transmitted in its active state, the germ or principle of the disease, whatever that may be—is transmitted hereditarily.

15. M. Briquet, from the history of 95 cases, arrived at the conclusion that hereditary tuberculosis developes itself in the form of phthisis at an earlier period of life than the disease does when acquired. In 39 of the cases with the history of hereditary transmission, 26 became phthisical before 30 years of age, while of 56 cases born of perfectly healthy parents 31 did not become phthisical until after 30 (l. c., p. 179); and it has been laid down by Fournet, that where the disease is hereditary it is in general chronic and characterized by large tubercles, but it would appear that one exception at least to this rule is furnished by young infants, in whom hereditary tuberculosis is occasionally acute and very rapid.

16. Tuberculous blood may be diseased to such an extent and its tuberculous state may be so uninterruptedly sustained, that it may transmit the predisposition or the disease hereditarily to two or several generations, it may then become more healthy and one or two generations may escape, after which it may acquire a new intensity, but in the latter case the renewed operation of the causes of acquired tuberculosis must be assumed. Hence hereditary transmission is so much the less to be feared, as the appearance of the disease in a family is removed to a distant generation.

17. When tuberculosis is transmitted by the blood hereditarily to several members of the same family, very often the tubercular disease does not assume the same form, nor occur at the same age, nor affect the same parts in all; one member will have hydrocephalus in infancy, another glandular enlargement in childhood, another white swelling of the joints or cold abscesses at puberty, and a fourth phthisis at a later period. In other instances, how-

ever, together with the tuberculous state of the blood, a predisposition to the local determination also of the disease is transmitted hereditarily, and several members of the same family will become affected with the same form of the disease, as with tubercular meningitis, tubercular phthisis, &c. The tendency to scrofulous ophthalmia is transmitted hereditarily, not only as respects the constitutional disease but in its local manifestation. (Cunier, l. c., p. 13). It is very frequently obvious that this predisposition to local disease depends upon the malformations and irregularities and defects of structure and the alterations of function, which are produced by the original disease of the blood and the aberrations of cell growth and nutrition which result from it.

18. Parents possessing a tuberculous constitution, without any manifestation whatever of local disease, may have tuberculous children who may die of scrofula or phthisis before they have given any indications of it themselves, and the parents may die subsequently of the disease. In this case the inference is that the tuberculosis has been transmitted from parent to child, the disease at the period of conception having been very slight, or latent, in the blood of the parent.

19. In general the chances of transmission increase with the number of children born, so that it frequently happens that the younger children die before the elder.

20. If a tuberculous husband marries successively two wives, both equally exempt from the disease, the children of the last wife will be more liable to the disease than those of the first.

21. The above inferences appear to me to flow from tuberculosis being regarded as a *disease of the blood*, and from the facts before us in relation to its hereditary transmission. Many of these are of the highest importance and are open to much discussion, and I wish it to be understood that I do not advance them dogmatically, but their full investigation is impracticable at this time as it would fill the remaining portion of the volume.

DIVISION II.

THE CAUSES BY WHICH TUBERCULOSIS MAY BE PRODUCED IN THE INDIVIDUAL.

Inasmuch as it cannot be assumed that the constitution of man *ab origine* was tuberculous, or that tuberculosis has been engrafted

on the human constitution without a cause, the real question of causation comes in this division. The facts in the foregoing division, I think clearly shew, that once engendered in the individual the disease is very frequently transmitted to the offspring, and this hereditary transmission is one of the greatest sources of its extreme prevalence in almost all communities; it would also prevent the immediate extinction of the disease even although all other causes were annihilated; but if it were proved that every case now occurring is the result of direct hereditary transmission, or if the whole human race were to become tuberculous from the same source, the question of causation would not be answered. When we approach this question closely we find that we have to consider it in reference to the disease, in any of its grades or forms, occurring congenitally; or to the disease as it occurs after birth. Hereditary tuberculosis is of course congenital, but that has been disposed of, and there is reason to believe that the disease may be congenital without being hereditary, hence the inducing causes refer to the individual, either during intra or extra-uterine existence, which require separate consideration.

SECTION I.

THE CAUSES BY WHICH TUBERCULOSIS MAY BE PRODUCED IN THE INDIVIDUAL BEFORE BIRTH.

I believe it is an indisputable physiological truth, that children may derive anomalies and modifications of the type of the species from which their parents and their families are perfectly free; such modifications being referrible to the very commencement of their being, that is to say, to the period of conception. There is very great reason to believe that diseases with which parents are not affected may take their origin or be generated in the progeny at the same period. Parents perfectly free from tuberculosis and from those recognized conditions of the constitution which act as predisposing causes, may conceive offspring, the primordial fluid germ of such offspring, the result of the union of the procreating materials, and the analogue and origin of the blood, being tuberculous. This is totally distinct from hereditary transmission, but has been very frequently confounded with it. As far as the individual is concerned, in both cases the disease is derived from conception; in the first case it is transmitted, and in the second it is begotten

or procreated by the parent; in both it is innate, connate or congenital.

This doctrine, that diseases may be originally produced at the period of conception, and that the offspring even of healthy parents may become affected with a disease from the earliest period of existence, is thus illustrated by a writer on the laws of generation—in the theory of interferences, he states, two rays of light may in a certain sense create obscurity; or the chemical combination, in certain proportions, of carbon, hydrogen and azote, three substances in their isolated state innocuous to the animal economy, may generate prussic acid, the most frightful of poisons; so, the vital combination and fusion of two healthy constitutions may in certain conditions give origin to a third which is morbid. (Lucas, lib. cit. vol. ii, p. 541).

I believe this, and nothing short of this, is the doctrine of Lugol. Admitting that it is perfectly consistent with the laws of generation, the term hereditary, as applied by this writer, is totally inapplicable to it, and very great obscurity has been cast over the subject, by discussing this question of the original production of the disease in the offspring from some defect or incongruity in the parents, under the head of "hereditary transmission."

Among the causes of the original production of tuberculosis in the fœtus, none is perhaps more probable than conception during the period that one or both of the parents is affected with other diseases. This, if admitted, amounts to a metamorphosis of the morbid element, whatever that may be. Baillou, Astruc, Bouvart, Baudar Lalouette, Pujol, Baumes, Hufeland, Portal, Lamauve, Poilroux, Sat-Deygallieres, Ricord, Lugol, Giraudeau de St. Gervais and others, among whom are the highest authorities in the literature of tuberculous diseases, are quoted as supporters of the doctrine of the transformation of syphilis affecting the father or mother, into scrofula in the infant. Some of them believe that scrofula has no other origin. Some, not liking to admit the doctrine of transmutation, believe syphilis and scrofula to be originally the same disease. Others, obliged to admit the radical difference and the hereditary transmission of each of the diseases in their proper form, limit the production of tuberculosis to certain stages of syphilis. Astruc believed that when scrofula is not transmitted directly from scrofulous parents it is derived in all cases from syphilis. Lugol entertains the most absolute conviction that syphilis produces scrofula.

Ricord limits the production to the period of the tertiary symptoms.

Dr. James Whitehead has lately revived the doctrine, that tuberculous affections in the offspring result from syphilis in the parents. He states, "I have known a family of children whose father suffered from both acute and chronic secondary syphilis in early life, of which he was considered perfectly cured before marriage, but who had, notwithstanding, a most violent attack of secondary disease of long duration, in the form of cutaneous eruptions and burrowing inguinal abscesses, commencing twelve months after marriage, and without any additional infection; his wife suffering at the same time under a train of symptoms of like nature. Two of the daughters died before the age of twenty years of phthisis, complicated with white swelling of the knee in both, diseases which had previously been unknown in the family of either parent.* The two sons suffered from syphilis in the usual form during infancy and childhood, the traces of which existed in adult life. The offspring of one of these bears evidence of the same taint in characteristic form." Dr. W. quotes from Portal some of the ancient and modern authors above enumerated, in favour of the doctrine—that the scrofulous taint is frequently a degenerated syphilitic taint; he does not believe that lues venerea passes into scrofula in the individual affected only, but also in the progeny thence issuing.†

This is not the place to describe the totally independent character of these two diseases in their special and general pathology, in their etiology, symptoms, and general history. The facts establishing this are sufficiently obvious and generally admitted. So that the only point of view in which the doctrine can hold, is the absolute transmutation of the syphilitic poison into the tuberculous element of disease. The doctrine is founded upon individual observations unsupported by any sufficient statistical data. However strong the individual illustrations (Lugol, Whitehead, &c.) may be, they can never be deemed sufficient to establish anything more than the possibility of the doctrine. There is no fact or experiment which conclusively proves that a single case of tuberculosis was ever produced by syphilis alone, and the circumstance that scrofula has prevailed to a great extent in districts and countries, and indeed in ages of the world unknown to syphilis, is conclusive against any considerable influence that it could exert.

* On Hereditary Diseases, preface, 1851, p. 8. † Idem, p. 240.

At the same time, syphilis, by its deleterious effects on the constitution of the parent, may probably weaken the reproductive faculty and lead to the conception of children who, from poverty of blood and debility of organization, are predisposed to tuberculosis, and it will have to be referred to again when the subject of the predisposing causes is before us.

The other causes of the original production of tuberculosis in the embryo and fœtus when it does not exist in the parent, which have been enumerated, are the following: 1. Conception during the period that the two parents are affected with different diatheses or diseases, and the reaction of the morbid elements of one disease on those of the other to produce a third. 2. The simple want of harmony and the reaction of the two temperaments of the parents on each other; it is said that the most opposite diseases may spring from this source. 3. Conception in localities favourable to the production of tuberculosis, or even under the insensible influences of the generating causes of morbid phenomena generally; it is said that the exciting causes of all diseases may affect the embryo through the parent without affecting the parent. 4. Conception during menstruation. 5. Sexual excesses and abuses. 6. Precocious marriages, both in the higher and the lower classes of society. 7. Too advanced age of the parent of either sex. 8. Ill-assorted ages of the parents; the husband being younger than the wife. 9. A comparative deficiency of generative power—the husband being more feeble than the wife—"a man can never energetically impregnate a woman who is much more vigorous than himself." (Lugol, p. 74). 10. Mental and physical shocks and impressions received by the mother during utero-gestation. 11. One of the parents being epileptic, apoplectic, lunatic, affected with scirrhus, cancer, gout, a disordered state of the digestive organs, cutaneous diseases, the injurious influence of mercury on the system, &c. &c.

A similar deficiency exists of proof of the production of tuberculosis in the offspring as a direct effect of the existence of any of these circumstances in relation to the parent, as stated in reference to syphilis as a cause of tuberculosis. At the same time, after giving much attention to this subject, I believe that it is perfectly consistent with the laws of generation that a disease may originate at the period of conception from an incongruity, deficiency or aberration of the elements which are to form the fœtus and are

derived from the blood of the parents, and with Lugol and others; I have witnessed cases that were referrible to this as a cause with greater probability than any other.

There can be no doubt that the whole of the circumstances enumerated may prove causes of a debilitated constitution of the offspring. Such debility is not tuberculosis, nor is it the tuberculous predisposition, but it may become a predisposing cause of tuberculosis when the individual is exposed to the more direct causes of the disease. In this point of view all these circumstances have the highest practical import, and will have to be referred to again in future sections.

The principal question in this section to which no solution can at present be arrived at, is—Whether a seminal secretion from blood exhausted of its reproductive principle in a debilitated state of the nervous powers, or a want of due elaboration of the semen, produces in the embryo that specific modification of the blood which constitutes tuberculosis, or whether it produces only a poverty of the fluids and debility of the organization, which renders them more susceptible of the tuberculous transformation.

The production of Tuberculosis in the Fœtus at periods of Utero-gestation subsequent to conception.—A pregnant woman may be subjected to a contagious disorder, and without taking it herself may convey it by the blood to the infant. Thus, a woman, 37 years old, in good health, who had been vaccinated, gave birth to an infant at eight months having the small pox, of which it died on the ninth day, the mother escaping. Numerous facts of this nature have been observed. So it may be inferred that a woman during pregnancy, subject to many of those circumstances which are believed to be capable of producing the disease at the period of conception, might produce it at any subsequent period of utero-gestation. If, for instance, a syphilitic condition of the blood in the parent can produce tuberculosis in the first instance, its occurrence or continuance during utero-gestation might render the blood of the fœtus tuberculous at any subsequent period, and so of any other cause which is operative through the mother individually. The fœtus is subject to external influences only through the mother, and it is not difficult to understand that the mother being free from tuberculosis at the period of conception, but subject to influences unfavourable to its nutrition during utero-gestation, may—without becoming tuberculous herself—become the me-

dium of the production of a tuberculous quality in the blood of the fœtus; the case of the fœtus in utero thus acquiring a tuberculous quality may be exemplified problematically in the continual action of the depressing passions, or of the other causes of acquired tuberculosis after birth on the blood of the mother. On this point we have absolutely no authentic facts to guide our judgment.

SECTION II.

THE CAUSES BY WHICH TUBERCULOSIS MAY BE PRODUCED IN THE INDIVIDUAL AFTER BIRTH.

That tuberculosis may be produced as a primary affection, without any hereditary taint, although positively denied by M. Lugol, is generally admitted. Dr. Mason Good furnishes a remarkable instance.* A gentleman was affected with scrofula and its sequelæ for many years, having affections of the joints and bones with ulcerations of the glands; he had eight brothers and sisters, at the middle period of life, who never exhibited any tendency to such a complaint, nor could it be traced to any part of the family lineage as far as it could be ascended. Instances of phthisis and other varieties of tuberculosis occur under similar circumstances. Laennec very justly remarks, that the most robust, and those of the most perfect bodily configuration are frequently cut off by this terrible disease, and he records the fact, that one family came under his notice in which the father and mother died upwards of eighty years of age, and of acute disease, after having seen fourteen children, born healthy and without any seeming predisposition, successively carried off by consumption between the ages of fifteen and forty-five.† Since the facts contained in the first part of this chapter clearly indicate that acquired tuberculosis is liable to become hereditary, and, with the exception that the disease may probably in some instances be engendered at the period of conception or during utero-gestation, there is reason to believe that in a great majority of cases a child is not born with the disease without one or both parents being previously affected with it in some degree, the true cause, or if more than one, all the causes, ought to be comprised under the present head. We shall use our best endeavours to analyse the mass of matter before us and to exhibit the real state

* Study of Medicine, vol. iii, p. 346.

† Trans., by Dr. Forbes, Ed. iii, p. 337.

of this great but obscure and difficult question; a subject, the elucidation of which, it may be stated unhesitatingly, is of more importance to mankind than any other in the whole range of practical medicine.

A.—OF THE PREDISPOSING CAUSES OF TUBERCULOSIS.

We hold that a predisposing cause of a disease must be something in the constitution—an internal cause—differing from the disease itself, but rendering the body more susceptible of being acted upon by the external, immediate or exciting causes. Hence, climate, temperature and other external agencies, whatever their influence, are not to be regarded as predisposing causes. Persons of all ages, of both sexes and of every variety of temperament, are subject to tuberculosis, but the opinion has ever been entertained that they are not equally so. Conclusions were formerly arrived at on this point without the aid of statistics, and no doubt erroneous and exaggerated views were entertained. Modern statistics are rendering our information on the causation of disease generally more definite, and as respects tuberculous affections, much labour has been bestowed and many of the results of former observation appear to have been invalidated. We find modern writers denying the influence of certain agencies and causes, but it should be at once observed that this denial is too frequently founded on very partial statistical data, and partial statistics may lead us into even greater errors than observation alone has done. In no case is this more likely to occur than in reference to tuberculosis. The statistics of phthisis, as repeatedly stated, are not the statistics of tuberculosis; the statistics of scrofula, of tuberculous meningitis, of mesenteric disease, are not the statistics of tuberculosis; and more especially the statistics of the mortality from these diseases, singly or combined, are not those of tuberculosis, nor would the most accurate numerical account of all the declared cases of the local diseases grafted on the tuberculous constitution be the statistics of tuberculosis. We can never hope to attain such a degree of certainty from statistical data which will allow us to reason as in a mathematical problem, until we are better acquainted with the specific alteration of the blood, and are enabled to form at least an approximative estimate of the proportion of the population affected, not only with the different

varieties of local disease, but with the constitutional affection in its various grades.

The predisposing causes are either physiological or pathological.

THE PREDISPOSING PHYSIOLOGICAL CAUSES.

1. SEX.

That the sex of an individual can have but very little influence in the causation of this disease may be inferred from very high authorities, who have investigated the subject, differing as to the frequency of the disease in relation to the sexes; and also from the fact that according to the more limited statistics of the mortality of the disease, it prevails most in the male sex in certain localities, and in the female sex in others; and sometimes, when the investigation has been made in the same place at different times, the results have been reversed.

Of 537 *scrofulous* subjects referred to in M. Lebert's work, and 141 in Dr. Balman's, 364 were males, and 314 females, from which it would appear that very little difference exists in the sexes as to the occurrence of scrofulous affection in the aggregate. In the Registrar General's Reports for England, Wales and Ireland, taking a period of four years, the deaths registered from scrofula are 4451 males, and 3228 females. (Mr. B. Phillips.) Taking the whole of England for 1847 the deaths were 1365 males to 1039 females. From this it appears, that not only the mortality from scrofula, but its occurrence in this country is most frequent in males, since these proportions are much greater than any disparity between the number of the sexes living would account for. The statements of continental writers differ remarkably from the results obtained by our own statistics on this point, but they are generally derived from individual experience on a more limited scale. Thus, according to Lepelletier, Guersant and Papavoine, the proportion of scrofulous females to males in the Parisian hospitals is as 5 to 3.

The ratio of mortality from *phthisis* to the number of individuals living in London and many of the large manufacturing and other towns in England and Wales, in 2 of 11 divisions into which the country is divided, and in 7 out of 42 counties, is greater in males than in females. The deaths from phthisis in London from 1843 to 1846 were 53 per cent. of males to 47 per cent. of females. (Dr. E. Smith.) An excess is also found among males in many

large continental towns, as at Hamburg, Rouen hospital, Naples hospital, New York (except among the black population), Geneva, and some other continental cities and localities. (Sir J. Clark, lib. cit., p. 183.) Leeds, however, has furnished an exception to this rule; the excess in this town having been found to be on the side of females.

These are instances of statistical results in certain localities and among comparatively limited numbers of individuals. Results directly the reverse are obtained in other localities and among numbers similarly limited. M. Benoiston de Châteauneuf found that of 43,000 patients admitted on account of various diseases into three of the Paris hospitals, 754 out of 26,055, or 1 in 35 males, and 809 out of 16,955, or 1 in 21 females, died from phthisis. M. Louis believes the mortality from phthisis is greater amongst females than males in Paris. The ratio of mortality from phthisis to the number of individuals living in 9 of the 11 divisions of England, in 31 out of 42 counties, and in 60 out of 95 districts, was found to be greater among females than males. (Dr. E. Smith.) The sum of Sir J. Clark's statistics for 13 different localities in Europe and America, including the localities in which the excess was on the side on the one hand of males, and on the other of females, is 17,330 females to 15,271 males.

MM. Rilliett and Barthez (lib. cit., p. 123) found in 329 deaths in boys, from 1 to 15 years of age, 195 were tuberculous, and in 196 deaths of girls 119 were tuberculous, the mortality from *tubercle* in young subjects being thus about 1·5 per cent. higher in girls than in boys; and M. Papavoine found that girls were more subject to tuberculization in the ratio of $^2/_3$ to $^7/_{13}$, or 67 to 54. The excess in girls is not uniform at different periods from 1 to 15 years, a point which has to be considered in connection with the subject of age as a predisposition.

Thus, if we were to confine our investigation to these comparatively limited series of results we might arrive at the conclusion that probably females are more liable to phthisis than males, and cases registered as phthisis constituting so large a proportion of the cases of tuberculosis, that, probably, females are more subject than males to the disease of the blood.

Let us now take a wider statistical range. According to the Registrar-General's first Report, the deaths from phthisis at all ages, during two years and a half (1837, 1838, 1839), in England

and Wales was 146,338, comprising 69,009 males and 77,329 females; the mean per centage for phthisis on the mortality of males being 17·99, and in that of females 26·7; 1 and 1·14 expressing the relative tendency to death from this form of the disease in the two sexes. But comparing the number of deaths of each sex from phthisis with the number living of each sex, estimated approximatively from the census, it appears that in this period the disparity between the two sexes is less—viz., as 1 for the male sex to 1·0675 for females. By the first method the ratio of mortality is 14 per cent. more for females, by the second consumption appears to occur in rather less than 7 per cent. more females living than males.* So also from the Irish Reports it appears that of 135,590 deaths from phthisis 63,635 were males and 71,955 females.

This excess in the mortality from consumption in females over males, and the probable excess in the occurrence of consumption in females, for the whole of England and Wales, has continued with little variation to the period of the last census. In England the respective ratios of the deaths from consumption to the population were:—

	MALES.		FEMALES.
In the year 1847	1 in 337·6	..	1 in 310·1

It is the opinion of Laennec and Louis, I believe generally concurred in, that the mortality from phthisis for the whole of France is greater in females than in males.

We have thus an excess of mortality from scrofula in the male sex, and an excess from phthisis in the female sex; we have in the next place the mortality from *tubercular diseases* taken together as shewn also in the general registry.

In 1847 the deaths at all ages were:—

	MALES.		FEMALES.
From scrofula	1,365	..	1,039
„ tabes mesenterica	2,455	..	2,125
„ phthisis	25,083	..	28,234
„ hydrocephalus	4,285	..	3,378
	33,188		34,776

This gives only 2·3 per cent. as the excess of mortality of the female over the male sex for tuberculosis generally, but 5·9 per cent. in excess for phthisis alone.

In 67,964 deaths registered "tubercular diseases" in the year

* The Medical Gazette, 1842, p. 175.

1847, from birth to 10 years of age, there are more deaths in males than in females; from 10 to 45 years the excess is greatly on the side of females, and from 45 years to extreme old age, with an unimportant exception, there is again an excess in favour of males. From phthisis *alone* more males are registered during the first two years; after which to the 45th years a great excess of females die; and subsequently to extreme old age, with one unimportant exception, more males. In all there are 33,188 fatal cases of tuberculosis in males to 34,776 in females. (Vide Table XIX.) The proportion of the population estimated to the middle of that year being as 8,368,914 males to 8,755,174 females.

These statistics establish one of two things—that the female sex is either, to a certain extent, a predisposing cause of tuberculosis, or that females in the mass are more exposed to the inducing causes. The circumstance that more males are born than females must tend to increase the ratio of excess on the side of females, since more males die from all causes. But even then the true excess, taking all forms of the disease, is really very small.

Two circumstances may be referred to as tending to explain this. 1. The blood of females contains fewer red corpuscles, and has a larger proportion of water than that of males, the corpuscles being as 99·1 in the former to 132·1 in the latter in 100 parts; (Lecanu;) the heart, arteries and lungs are also smaller and of lesser density, and the vigour of the circulation is less. But this condition is in relation to the entire organization of the female, and we should say *à priori* that its influence could be but small. The qualities of the tuberculous blood resemble in some respects those of the healthy blood of the female, and admitting that the female sex is predisposed to the disease, the fact that it has so slight an influence shews that these qualities of the blood by no means constitute the essential character of the blood disease, and that the modification of the blood is a specific change differing entirely from a mere change in the proportions of its grosser constituent parts. 2. The more probable explanation is that the female sex transmitting tuberculosis hereditarily more frequently than the male sex it probably transmits it more frequently to the female than to the male offspring.

Facts are by no means wanting to induce us to pause before we admit that sex is even to this extent a cause of tuberculosis. The varying and sometimes contradictory statistical results are of this

nature; and we are at present so little acquainted with the true efficient causes that we cannot explain these variations. Admitting for a moment that both sexes are equally, or nearly so, affected with the disease of the blood from hereditary transmission or from exposure to anti-hygienic influences, we find that males are more liable to scrofula than females, and those who have an outbreak of scrofula frequently escape the consummation of the disease in the form of internal tuberculization. Males again appear to be more liable to hydrocephalus and tabes mesenterica, and those who die of these forms of the disease are of course not found in the registry of phthisis. Here are reasons for the admitted fact that females die of phthisis more frequently than males. As an illustration of the facility with which the ratios are altered as respects the local development and probably the original production of the disease in the two sexes, it would appear that according to the statistics of the Consumption Hospital (Dr. T. Thompson, Lancet, Dec. 1851) *married* women above the age of 25 years die of phthisis less frequently than *married* men in the proportion of 3 to 5. Dr. Thompson refers this to moral causes.

I am inclined to believe that females affected with tuberculosis escape local disease in the various forms of scrofula more frequently than males, at all events in this country, and hence the preponderance of scrofula in the male sex; moreover, that the constitutional disease is more frequently spontaneously cured by treatment, the efflux of time, and the progressive changes of the blood as age advances, or by altered habits and hygiene. This remark applies especially, but not altogether, to the disease manifesting itself in the scrofulous forms rather than to internal tuberculization.

The circumstance that sex has so slight an influence as a predisposing cause, accounts for the contrary results obtained from limited statistical data. Other causes of the disease so easily modifying and even reversing the numerical proportions in a small number of individuals of the two sexes.

The liability of the sexes to special forms at particular ages, belongs to a future stage of the enquiry, but it is necessary to remark here, that the greater liability of the one or the other sex at different epochs of life, is a different question from that of the total relative liability; at present I consider that the only affirmation warranted from the facts before us is, that in this country

there is presumptive evidence of the female sex operating in a slight degree as a predisposing cause of tuberculosis.

2. THE LYMPHATIC TEMPERAMENT.

From the earliest ages until very recently the lymphatic temperament has been regarded, from observation alone, sometimes as the first degree of tuberculosis (scrofula), and at others as an unequivocal and very influential predisposing cause of scrofula and phthisis, and it was not until the adoption of the numerical method that this opinion began to be doubted. The indefinite line of demarcation between the temperaments renders it very difficult to determine this question, and the difficulty is increased by the fact, that many of the effects of a tuberculous state of the blood on the animal economy, are analogous to the characters of the lymphatic temperament.

Of 9000 children in London examined by M. Phillips, having the marks of scrofula adopted by him as diagnostic signs of the disease, a little over 32 per cent. only had light hair and eyes; but I have already pointed out the too limited character of these diagnostic marks. M. Lebert states, that the etiological influence of this temperament has been greatly exaggerated, and he even goes so far as to dispute it altogether. (Lib. cit. p. 64.) M. Fournet thinks phthisis is met with more frequently in a moderate than in a highly lymphatic temperament, being very rare in the latter. (L. c. p. 510.) In Dr. Balman's 141 cases of scrofulous external glands, observed in Liverpool, 48 per cent. had light hair and complexions, and 34 per cent. dark or black hair and eyes. Dr. Balman appends a very important remark to this statement (l. c. p. 10)—that it is explained by the fact that the larger proportion of the population in the North of England is of the fair-haired race. This remark shews the insufficiency of our data to determine this question numerically; for, if in other districts of England the Celtic or dark-haired races predominate, a larger proportion of cases may occur in dark-haired individuals, without invalidating the opinion that the opposite temperament operates as a predisposing cause. We ought to know the proportion of the different temperaments in the whole population, and ascertain the ratio of the number of tuberculous individuals to the number of individuals of each temperament, in order to estimate it correctly.

We are thus thrown back upon the general opinion corrected

by these imperfect statistics, that the lymphatic temperament is a predisposing cause, but that its influence has been greatly exaggerated.

The fact that the blood of individuals of this temperament possesses some of the most prominent physical characters of tuberculous blood, differing from the blood in the sanguine temperament—in the proportion of its red corpuscles, which is small (116·6 parts as compared with 136·4 parts in the thousand, with 800·5 of water as compared with 786·5 parts, (Lecanu), there being also a small increase in the proportion of albumen, the red corpuscles probably developing themselves slowly, and the blood containing a larger proportion of old corpuscles, (Schultz,) thereby indicating a diminished vitality, might at first sight lead to the inference that tuberculous blood is essentially the same as lymphatic blood. But, although the above qualities are common to both, in the latter there is no evidence whatever of the vitiated state of the plastic constituents which obtains in the former; and the lymphatic temperament, however well marked, is not to be confounded with even the minor shades of tuberculosis; there are a few circumstances in which the temperament resembles it, yet it is exempt from most of the specific peculiarities of structure and function, described in the first chapter, as characterizing the tuberculous predisposition. Lymphatic blood will never of itself become tuberculous, nor can it produce the effects which result from the latter. As in the case of the female sex, so of the lymphatic temperament—that they are not more influential as predisposing causes of tuberculosis, than we now find to be the case, are corroborative proofs, admitting its seat to be in the blood, that the disease consists of a vitiated condition of this fluid, *sui generis*, as stated in the first chapter of this work.

3. AGE.

The most cursory observation leads to the conclusion, that particular tuberculous affections are of more frequent occurrence at certain periods of life than at others. Tubercular meningitis, for instance, occurs in infancy; scrofula is most frequent in childhood and early life; and phthisis in early adult life. There are many statements extant, founded on very partial data, as to the relative frequency of phthisis at different ages and epochs of life, and as to the influence exerted by age, considered *per se*, over

the production of particular forms of the disease. Hitherto, however, no attempts appear to have been made to determine the relative frequency of tuberculosis, viewed as the origin of internal and external scrofulous and tuberculous affections; or, to determine whether the history and progress of these local affections is influenced by any law relating to the development of the disease of the blood at the different periods of life. The view I have taken of tubercular local diseases as manifestations of a special morbid condition of the blood, has led to interesting and unexpected results under this head.

Before any conclusion can be arrived at as to the influence of age in the production of the disease, it is necessary to consider the subject of—

1. *The probable duration of tuberculosis.*—Children are frequently born with an hereditary predisposition to the disease, and with many of the characters of the tuberculous constitution well marked, they live for many years without any manifestation of it in an active state, and, under favourable circumstances, the blood becomes renovated, and with the exception of those prominent traces which are necessarily indelible, such as irregularities of the bony skeleton, they lose all its traits, and attain longevity, or die prematurely, of other diseases. Children born with tuberculosis, or who acquire it at an early period, may also be attacked with local disease which may endure for a long series of years, and ultimately terminate either in recovery or death; we see this especially in various affections denominated "scrofula." When tubercle is deposited internally, it is true, that in a vast majority of cases, death takes place within a limited period, but there can be no doubt whatever, even where it occurs in the lungs, that tuberculosis may continue for ten or more, and in exceptional cases twenty or even thirty years.

The duration of the constitutional disease has been measured by the duration of its local manifestations, but it is at once obvious that the latter can be no accurate measure of the former; it is rather a measure of the intensity of the disease of the blood, or of the duration of tubercular disease of special organs, or of the particular phase of the development of the morbid condition of the blood.

It is also extremely difficult to determine the duration of local tuberculous affections. The influence of age as a predisposing

cause is in almost all cases deduced from the statistics of the mortality at different ages, but when the uncertainties of the period at which local disease commenced is taken into the account, and how unequal and indeterminable is the duration even of the local manifestation, with the above facts relating to the constitutional state, it will at once appear that these deductions are based on data requiring very considerable qualifications.

The following statistics of the duration of various local tubercular affections—internal and external—assist us in forming an opinion as to the duration of tuberculosis from the period at which local disease has established itself.

TABLE XVI.

The duration of the principal forms of external tuberculous diseases, including diseases of the bones. From M. Lebert. The figures in the parentheses indicate the number of cases complicated with pulmonary tubercles.

Duration.	99 cases of tuberculosis of the external glands, simple and complicated.	52 cases of tuberculous cutaneous affections.	105 cases of tuberculous abscesses, ulcers, &c.	71 cases of tuberculous ophthalmia.	86 cases of tuberculous diseases of joints.	168 cases of tuberculous diseases of bones.	581 cases of tuberculous disease.
1 to 6 months	9 (1)	3	12	10 (4)	6	14	54
6 „ 9 „	7	..	9	2 (2)	6	10	34
9 „ 12 „	13 (1)	9	13	4	14	26 (3)	79
1 to 2 years	24 (6)	17	29	21 (6)	31	37 (5)	159
2 „ 3 „	19 (3)	10	15	9 (3)	8	26 (5)	87
3 „ 4 „	4	4	6	5 (2)	5	13	37
4 „ 5 „	5 (2)	2	6	5	6	12 (1)	36
5 „ 6 „	7	4	6	6 (4)	8	13 (3)	44
6 „ 7 „	3	..	3	1	1	4	12
7 „ 8 „	2	..	2	..	1	3	8
8 „ 9 „	2	..	2	2 (1)	..	4 (1)	10
9 „ 10 „	2	2	2	3	..	6 (1)	15
10 „ 11 „	..	1	..	1	..	..	2
11 „ 12 „	1	..	..	..	..	..	1
12 „ 13 „	1	..	..	1 (1)	..	..	2
13 „ 16 „	..	..	..	1	..	..	1
	99 (13)	52	105	71 (23)	86	168 (19)	581

This table is the more important since it is not a table of *mortality*. The occurrence of tubercles in the lungs was the only circumstance which appeared to accelerate the disease when seated in the glands. The duration of disease of the glands was not much influenced whether tubercle was deposited there or not. The mortality in those cases which were not complicated with pulmonary tubercle was very trifling, and hence, M. Lebert observes, there are

no exact data to fix the limits of duration. Another source of difficulty is the impossibility of knowing whether an individual apparently cured is so in reality. The external affection may be cured but the disease of the blood remaining, in however trifling a degree, it may break out again in the same or some other form, and this may happen 15 or 20 years subsequently. We have absolutely no means of deciding whether the disease is extinct or not.

In 215 fatal cases of phthisis at the hospital for consumption the duration was as follows :—

	NO. OF CASES.
Less than three months in	1
From 3 to 6 months	22
„ 6 „ 9 „	36
„ 9 „ 12 „	30
„ 12 „ 18 „	34
„ 18 „ 24 „	22
„ 2 „ 2½ years	23
„ 2½ „ 3 „	6
„ 3 „ 3½ „	9
„ 3½ „ 4 „	4
Above 4 „	14
Doubtful	14
	215

Thus more than half the entire number of cases, omitting the doubtful ones, were fatal within a period of 18 months (123 to 78). The disease was more rapidly fatal in males than females. (Report, 1849, p. 33.)

In 193 cases observed by Louis the duration was :—

Less than a month in	1
One „	3
From 35 to 84 days in	11
„ 3 „ 6 months in	52
„ 7 „ 12 „	62
„ 12 „ 24 „	41
„ 2 „ 8 years	23
	193

There is no known limitation to the period during which the tuberculization of an organ may remain stationary, and this remark applies to tubercle in a crude state still susceptible of its destructive progression as well as to tubercle undergoing either of the curative processes (p. 139). The only circumstance that appears to operate is that tubercular matter seldom if ever continues stationary after softening commences. Although there are numerous

exceptions to the rule that the deposit of tubercle proves the beginning of the end, it is very rare that the softening of tubercle does not rapidly lead to the termination of the disease.

From other statistics also before me, which are by far too numerous for insertion, it appears upon the whole, that both scrofula and phthisis run a more rapid course in the male than in the female sex, but this is subject to great variations arising out of many circumstances; nor is it by any means constant in all forms of the disease; thus, in Lebert's statistics, affections of the bones more frequently run a rapid course in males than in females, and affections of the joints more frequently in females than males. Sir J. Clark remarks that in the upper ranks of life, where patients are placed under the most favourable hygienic circumstances, the medium duration of phthisis is probably not much short of three years, but under other circumstances it is less. In hospital practice the medium duration is found to be much less.

2. *The relative frequency of Tubercular Local Diseases at the different periods of life.*—In Lebert's interesting work (p. 60) we find a table of the ages of 1055 individuals who died of tuberculous affections in four years, in the Canton of Geneva, drawn from the bills of mortality; the number 1055 being reduced by the author to the standard of 1000. In the same work there is also a table of the ages of 537 persons affected with the various forms of scrofula, under the author's own observation also reduced to the standard of 1000. By combining these two tables I have constructed a third, which gives the proportions at the different ages of 1000 persons affected with tuberculosis either in the form of scrofula or tuberculous deposit.

TABLE XVII.

Age.	Of 1000 persons affected with Tubercle.	Of 1000 persons affected with Scrofula.	Of 1000 persons affected with one form or the other of Tuberculosis.	
From 1 to 5 years	93	128	110	3
„ 5 to 10 „	51	262	156	2
„ 10 to 15 „	57	292	179	1
„ 15 to 20 „	84	162	123	4
„ 20 to 25 „	142	52	97	5
„ 25 to 30 „	129	39	84	6
„ 30 to 35 „	111	26	68	7
„ 35 to 40 „	106	19	62	8
„ 40 to 45 „	64	19	41	9
„ 45 to 50 „	60	——	30	10
„ 50 to 60 „	63	——	31	11
„ 60 to 70 „	39	——	18	12
„ 70 to 80 „	06	——	03	13

This table shews a difference in the relative frequency of internal and external tuberculous diseases at the different periods of life. While, as respects internal tuberculosis, with the exception of the first quinquennial period, a gradual increment occurs from under five years to adult life (25 to 30 years), and after that, with one unimportant exception, a gradual decrement; external tuberculosis shews a more rapid increment to the age of fifteen, and after that a more rapid decrement; ceasing altogether at a much earlier age than the former. So that after 45 the liability to external disease appears to be worn out, while that to internal disease continues many years longer, although in a very rapidly decreasing ratio.

TABLE XVIII.

Shewing the relative frequency of the principal forms of External Tuberculous Affections, with diseases of the bones, simple or complicated with tubercle, at different ages. The figures in parentheses indicate the number of cases in which tubercle was deposited internally or externally.

Age.	175 Tuberculous affections of the External Glands.	116 Tuberculous affections of the Skin.	140 Tuberculous Abscesses, Ulcers, &c.	160 Tuberculous Ophthalmia.	119 Affections of Joints.	302 Diseases of the Bones.	1012 Tuberculous external affections, including diseased Bones.
1 to 5 years	13 (11)	15 (6)	11 (1)	29 (4)	9 ..	37 (5)	114
5 to 10 ,,	33 (17)	40 (5)	38 (2)	50 (7)	31 (2)	78 (9)	270
10 to 15 ,,	52 (28)	31 (5)	42 (4)	50 (18)	39 ..	80 (10)	294
15 to 20 ,,	46 (25)	21 (7)	19 (3)	20 (10)	19 (4)	51 (10)	176
20 to 25 ,,	11 (6)	3 (1)	10 (3)	6 (2)	8 (1)	20 (4)	58
25 to 30 ,,	5 (3)	3 ..	6 ..	2 ..	6 (2)	13 (2)	35
30 to 35 ,,	6 (5)	2 ..	8 (3)	1 ..	5 ..	9 (3)	31
35 to 40 ,,	7 (2)	1 ..	2 (1)	1 (1)	1 ..	6 ..	18
40 to 45 ,,	2 (1)	.. ..	4 ..	1 ..	1 ..	8 ..	16
	175 (98)	116 (24)	140 (17)	160 (42)	119 (9)	302 (43)	1012

Although this table does not represent 1012 cases, many of the affections having occurred together in the same individual, it is still valuable, as giving an approximative view of the relative frequency of the included local diseases, at the different periods of life.

When the whole of the local diseases are grouped together, in the fourth column of Table XVII, we observe a progressive increment from one to fifteen years, without interruption; and from that period till extreme old age, an uninterrupted progressive decrement. This result induced me to examine the tables of the Registrar General, with a view to ascertain the relative mortality at different

ages—not of the particular local affections alone, but—of the sum of the local affections—so as to ascertain whether the results bear out the inference which might be drawn from the last mentioned table, as to the influence of age over tuberculosis as a disease of the blood.

The classification by the Registrar General of the four principal forms of tuberculosis under the general head of "tubercular diseases," has enabled me to construct Table XIX.

In this table the sum total of the population in the last line differs from the sum total of the numbers for the different periods of life as nearly as possible 53,000 or ·3 per cent., owing to about that proportion of the ages not having been specified at the census of 1841.

There can be no doubt that the table contains errors. The cases of hydrocephalus recorded at advanced periods of life, for instance, are most probably, in the greater number of instances, misnomers. Some of the cases of scrofula may be the same, or cases of internal tuberculization may be registered as scrofula. But these errors are not sufficient to invalidate its broad statistical basis. Medical statistics must in all cases be admitted with some qualification, owing to the imperfections of the science and the difficulty in collecting uniform data.

On examination this table exhibits among its most prominent features: 1. A nearly progressive increment in the ratio of the deaths from tubercular diseases to the deaths from all causes throughout the periods from 1 to 25 years of age. 2. An uninterrupted and rapid decrement from 25 to 95 years, at which age the disease for that year became extinct.

The table requires to be studied in juxta-position with the statistics of the duration of the disease. It then becomes perfectly clear that the enormous proportion of deaths at 20 to 25 years of age is not wholly referrible to the period of life. In more than half the deaths that take place at the age of 20, the local disease has existed above one and from that to four, eight, or more years, and the same of any other period. The period of the greatest mortality is not so much that of the occurrence, as the period of the most frequent consummation—the end—of the disease. General experience confirms this view of the case; for who has not witnessed life frequently protracted to adult age, where local disease has manifested itself many years previously, or where it

TABLE XIX.

The Mortality during the year 1847 *from Tubercular Diseases (four principal forms) in Males and Females at Twenty-four periods of life; making a Total of* 67,964 *cases; with the Mortality from all causes* (420,977) *in the same periods. To which is appended the estimated Population to the middle of the year* 1847 *for each period, with the ratios of the Mortality from Tubercular Diseases to the Mortality from all causes, and to the Population also, at each of the periods.*

Years.	Mortality from Tubercular Diseases.							Mortality from all causes.			Estimated Population in the middle of the year 1847.			Ratios of the Deaths from Tubercular Diseases.		Ratio of the Mortality from all causes, to the estimated Population.
	Disease.	Males.		Females.		Both Sexes.		Males.	Females.	Both Sexes.	Males.	Females.	Both Sexes.	To the deaths from all causes	To the Population.	
Under 1	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	93 905 1251 1319	3568	88 719 1164 942	2913	181 1624 2415 2261	6481	49,547	39,237	88,784	215,150	234,959	450,109	1 in 13·7	1 in 69·4	1 in 5·1
1 to 2	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	65 569 676 1127	2437	55 488 656 859	2058	120 1057 1332 1986	4495	16,666	16,019	32,685	230,463	230,038	460,501	1 in 7·2	1 in 102·2	1 in 13·7
2— 3	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	42 278 318 490	1128	40 255 345 435	1075	82 533 663 925	2203	8909	8513	17,413	233,383	235,187	468,570	1 in 7·9	1 in 212·7	1 in 26·9
3— 4	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	28 157 212 321	718	27 141 212 271	651	55 298 424 592	1369	5870	5803	11,673	217,806	221,556	439,362	1 in 8·5	1 in 320·9	1 in 37·5
4— 5	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	34 82 179 232	527	20 59 182 182	443	54 141 361 414	970	4123	4137	8260	215,225	215,026	430,251	1 in 8·5	1 in 443·6	1 in 52·1
5—10	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	165 257 780 543	1745	110 189 876 442	1617	275 446 1656 985	3362	9768	9369	19,137	1,020,042	1,022,576	2,042,618	1 in 5·7	1 in 607·6	1 in 106·7
10—15	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	172 88 910 146	1316	118 94 1432 131	1775	290 182 2342 277	3091	5101	5330	10,431	942,534	915,115	1,857,649	1 in 3·4	1 in 600·9	1 in 178·1
15—20	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	165 41 2294 31	2531	119 36 3232 45	3432	284 77 5526 76	5963	6615	7126	13,741	836,845	865,094	1,701,939	1 in 2·3	1 in 285·4	1 in 123·8
20—25	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	150 18 3521 14	3703	76 27 3899 24	4026	226 45 7420 38	7729	8241	8324	16,565	774,542	888,360	1,662,902	1 in 2·2	1 in 215·1	1 in 100·3
25—30	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	111 3 2983 12	3109	54 20 3683 11	3768	165 23 6666 23	6877	7216	8190	15,406	657,138	722,120	1,379,258	1 in 2·3	1 in 200·5	1 in 89·5
30—35	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	68 13 2373 9	2463	75 28 3094 4	3201	143 41 5467 13	5664	6626	7623	14,249	604,706	646,972	1,251,678	1 in 2·5	1 in 221·8	1 in 87·8
35—40	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	42 12 2212 6	2272	47 14 2545 3	2609	89 26 4757 9	4881	6833	7387	14,220	465,847	482,871	948,718	1 in 2·9	1 in 194·3	1 in 66·7
40—45	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	44 3 1847 6	1900	43 12 1903 7	1965	87 15 3750 13	3865	6909	6917	13,826	466,338	486,047	952,385	1 in 3·6	1 in 246·4	1 in 68·8
45—50	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	42 3 1534 4	1583	31 5 1404 4	1444	73 8 2938 8	3027	7135	6462	13,597	345,472	349,380	694,852	1 in 4·4	1 in 229·5	1 in 58·5
50—55	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	37 4 1261 8	1310	24 7 1111 4	1146	61 11 2372 12	2456	6981	6684	13,665	328,848	351,469	680,317	1 in 5·5	1 in 281·1	1 in 49·8
55—60	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	39 4 1025 4	1072	37 12 874 3	926	76 16 1899 7	1998	7615	6982	14,597	202,956	217,199	420,155	1 in 7·3	1 in 210·3	1 in 28·8
60—65	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	19 5 749 3	776	20 8 715 5	748	39 13 1464 8	1524	8703	8725	17,428	223,801	247,912	471,713	1 in 11·4	1 in 310·8	1 in 27·1
65—70	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	20 3 515 6	544	24 5 505 1	535	44 8 1020 7	1079	9220	9323	18,543	129,211	149,231	278,542	1 in 17·2	1 in 267·4	1 in 15·
70—75	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	18 5 253 ...	276	17 2 246 3	268	35 7 499 3	544	9935	10,782	20,717	111,365	129,120	240,485	1 in 38·	1 in 442·	1 in 11·
75—80	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	10 3 128 1	142	10 4 109 1	124	20 7 237 2	266	9357	10,552	19,909	59,546	69,089	128,635	1 in 74·8	1 in 483·2	1 in 6·5
80—85	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	... ... 41 2	43	3 ... 26 ...	29	3 ... 67 2	72	6651	7799	14,450	33,295	42,745	76,040	1 in 200·6	1 in 1056·1	1 in 5·3
85—90	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	... ... 9 ...	9	1 ... 10 ...	11	1 ... 19 ...	20	3487	4380	7867	10,770	14,881	25,651	1 in 393·3	1 in 1282·5	1 in 3·3
90—95	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	... 1 2 ...	3	... ... 3 ...	3	... 1 5 ...	6	1006	1571	2577	2662	4333	6995	1 in 429·5	1 in 1165·7	1 in 2·7
95 &upwards	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	... ...	...	... ...	...	... ...	...	302	538	840	622	1175	1797	.....	.....	1 in 2·1
All ages	Scrofula Tabes Mesenterica Phthisis Hydrocephalus	1365 2455 25,083 4285	33,188	1039 2125 28,234 3378	34,776	2404 4580 53,317 7663	67,964	213,076	207,901	420,977	8,368,914	8,755,174	17,124,088	1 in 6·2	1 in 251·9	1 in 40·7

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has been impossible to define when it commenced? But if this qualification is demanded on account of the duration of the local disease which may have destroyed the patient, how can we determine when the diseased state of the blood commenced. Doubtless it occasionally happens that an individual in good health becomes rapidly tuberculous, and as rapidly dies of phthisis or mesenteric decline, but in a very large majority of the cases a feeble state of health—a tuberculous state of the blood—has existed for a long period before the slightest indication of local tubercular development. Of those who die of the four forms of the disease represented in the table in such large numbers, in early adult age, many were tuberculous from birth; and others, being subjected to the more direct causes, acquired the diseased state of the blood many years previously.

Let this table of the mortality at the different periods of life be now examined in connection with Tables XVII and XVIII, which represent the relative frequency of different forms of the disease, also at the different periods of life. In the first named table we find that although phthisis, the most fatal form of disease, is comparatively infrequent up to the 20th year, the external forms of tuberculosis are of much more frequent occurrence during a great part of that period than subsequently, and on examining the fourth column it appears, that the incremental series extends only from the first to the third period, that is to say, at the utmost to the 15th year, after which the frequency of the disease of the blood as represented by the occurrence of phthisis and scrofula, observes an almost uniform decrement.

Bearing in mind the long duration of the disease, the comparative infrequency now reduces itself (as far as the evidence before us goes) to the two first periods of life, and according to the table of mortality, probably to the first five years. But—*Is* tuberculosis less frequent in its occurrence from birth to five years of age than at subsequent periods?

A close examination of the mortality, as indicated by the tables of the Registrar General, does not merely cast a doubt, but answers this question, *probably, if not certainly, in the negative.*

In 1847, under the head of "Diseases of the Nervous System," 25,811 deaths are registered from birth to five years of age, and 23,347 of these as "convulsions"; under the head of atrophy 7,172; and under that of premature birth and debility 15,244;

in all 45,763 out of a total mortality of 158,815; or 1 in 3·1 in the same period. Deducting the 15,518 registered as tubercular diseases 1 in 2·5. Post mortem examinations are made in a very few of these cases, else many would not be registered under such denominations.

No doubt can exist that a great proportion of these 45,763 cases are cases of tuberculosis, terminating at an early period by gradual emaciation and debility, without the deposit of tubercle; or with tubercular disease of the mesentery, the lungs, and especially of the brain. When we find that to MM. Rilliett and Barthez the autopsy disclosed 314 cases of the internal deposit of tubercle, to 211 in which it was absent, out of 525 deaths from all causes, of young subjects under the age of 15 years, the truth of this proposition scarcely can be questioned.

If the whole 45,763 cases consisted of tuberculosis they would raise the mortality to 1 in 2·5 of the deaths from all causes, instead of 1 in 10 as it will be found to stand in the table. But so extreme a supposition as this is not necessary to shew that tuberculosis is probably most frequent in the earliest periods of life. To the mortality during that period, we have to add the indefinable amount of mortality of the cases occurring during that period but dying subsequently, together with the statistics of recovery.

Analogous facts, and a similar line of argument establish the probable greater frequency of the disease of the blood during the first, than at any subsequent year. The deaths from all causes at that period in 1847 were 88,784, the deaths registered "tuberculous diseases," and those registered "atrophy, debility, and premature birth, convulsions," and those "not specified," 52,667; that is to say 1 in 1·13 of all the deaths, or 1 in 8·7 of the children living at that age. These figures will only show the probable higher mortality from tuberculosis, than appears from the number of deaths registered "tuberculous diseases," but when we consider the character of the disease, although shorter in infancy than at after periods, it is certain that a very large proportion who either inherit a tuberculous state of the blood, or who become tuberculous from birth to one year of age, do not die tuberculous during the year, but contribute to swell the numbers of those who do at subsequent periods of life, and especially at those periods which present the highest rate of mortality.

The ratios of the deaths from tubercular diseases to the population, are much less regular than the ratios of the deaths from these diseases, to the deaths from all causes. According to the first, tuberculosis is to a very great extent proportionately more frequent during the first year of existence than at any subsequent period, and becomes gradually less frequent until 10 to 15 years of age; after which, its proportionate frequency increases, but fluctuates till 65 to 70 years of age, when it again rapidly declines. I believe the second criterion—the ratio to the deaths from all causes—is better, as a whole, to form an opinion on the relative frequency of a disease at different ages, inasmuch as the fluctuations of the population affect the results, and that the ages of adults given at a general census are notoriously incorrect. It is to be observed also, that the fluctuations in the ratios in the last column indicate—not the fluctuations of the ratios of the deaths from tuberculosis alone—to the population, but of the deaths from all causes, so that it is the liability to death from *any* cause which fluctuates.

As a further illustration, derived from another source, that the decremental series is at no time in an equal ratio with the deaths from all causes, or the mortality of the human species, we find that in the year 1842, of 1898 deaths from all causes in the London hospitals, 330 died from consumption, scrofula, and mesenteric disease, at the following ages :—

TABLE XX.

Age.	Consumption.	Scrofula.	Tabes Mesenterica.	Total.
1	..	1	..	1
5	3	1	1	5
10	4	2	..	6
15	25	..	..	25
20	91	3	..	94
30	88	1	..	89
40	62	..	..	62
50	37	..	..	37
60	10	..	..	10
70	1	..	..	1
.	321	8	1	330

This table is in accordance with the former, the highest mortality being from 20 to 25 years of age. The mortality from all causes from 20 years was as follows :—

At	20 years	. . . .	364 individuals.
„	30 „	. . . .	376 „
„	40 „	. . . .	369 „
„	50 „	. . . .	252 „
„	60 „	. . . .	137 „
„	70 „	. . . .	68 „

But

Deaths.			Deaths from tuberculosis.		Deaths.					
As 364	at 20	years	: 94	::	376	at 30	years	: 96	vice	89
„ 364	„ 20	„	: 94	::	369	„ 40	„	: 97	„	62
„ 364	„ 30	„	— 94	::	252	„ 50	„	: 65	„	37
„ 364	„ 20	„	— 94	::	137	„ 60	„	: 37	„	10
„ 364	„ 20	„	— 94	::	68	„ 70	„	: 17	„	1

Here the rapidly diminishing liability to death from tuberculosis is very evident. If we compare the two last columns we find,—not that the decrease is *absolutely*, as the number of deaths from all causes decreases, but *relatively;* that is to say, if tuberculosis were as frequent or as fatal a disease at 70 years of age as it is at 20, *seventeen* of the above individuals ought to have fallen a sacrifice instead of *one*.

3. *The influence of age as a predisposing cause of Tuberculosis.*—The conclusions I arrive at are—

1. That age is a true predisposing physiological cause of tuberculosis, and that it is infinitely more efficient than any other predisposing cause.

2. That, although, statistics do not at present enable us to enunciate a law of progressive decrement, there is great reason to believe that the susceptibility of the blood of man to the tuberculous transformation, is greatest at the earliest periods of infancy, and progressively diminishes as age advances.

3. That, although, physiological and pathological chemistry do not enable us to explain this change in the degree of susceptibility of the blood, and of the organic structures generally to the disease, it is an undoubted fact, that both undergo modifications as age advances. The blood is less abundant in solid constituents and blood corpuscles in early life than from the period of maturity to middle life; after 40 or 50 years, MM. Becquerel and Rodier found a decided and progressively increasing proportion of cholesterine, and as age advances it becomes more venous in its character. Without any definite information before us of the nature of the specific modification which constitutes tuberculosis, it can only be offered as a conjecture, or probability, that the progressive changes

of the blood as age advances, render it less and less susceptible of the tuberculous transformation; and where the tuberculous elements exist, that they tend to counteract its progress and effects, if not to promote its elimination or to supersede it.

4. A great number of facts, in the chapter on the pathological anatomy of the disease, tend to support this view of the case, particularly those which relate to tuberculization in infancy and childhood and advancing years (pp. 283, 362, 363). When the disease affects the youngest subjects, miliary and yellow tubercles diffuse themselves over numerous organs, and it runs a rapid course; when it occurs in advancing years it is in general slow, and the deposit of tubercle is mostly limited to one organ and even to a small portion of that organ (p. 364). The occurrence of local disease in the organs connected with hæmatosis is more frequent in early life (pp. 242, 299, 302, 348, &c.). To these observations may be added the fact, which has been admitted by the most experienced and best observers, that the occurrence of external tuberculous affections became frequently prophylactic against the internal deposit of tubercle, and accordingly curative of the disease.

5. Although the susceptibility to the disease begins to decline and gradually diminishes from a very early age downwards, the liability to death from this disease does not begin to wear itself out until after 20 or 25 years. This circumstance is fully exhibited in the preceding tables; and the diminished liability to death from tuberculosis is remarkably illustrated by the fact that in people dying of other disease at advanced periods of life evidence of the previous existence of tuberculosis is very frequently met with (p. 364). In advanced life not only is the susceptibility to all the external diseases denominated "scrofula" extinct, but, although tubercle may be deposited internally, it is less likely to produce fatal consequences.

6. It appears from the tables, that not only as age advances the blood becomes less liable to the tuberculous transformation and the sum of tuberculous disease diminishes, but that particular ages and epochs, to a certain extent, predispose to particular varieties and forms of tuberculosis. The second and third columns of Table XVII exhibit this in reference to external tuberculous affections and the internal deposit of tubercle. The former are by far the most frequent in infancy, and continue to increase until 15 years of age, after which they progressively and rapidly decrease with the age

of the individual, until from 40 to 45 years, when they are very rarely met with. This would appear to indicate, that the tuberculous state is so tempered, as it were, by the natural qualities of the blood in early life, as to render the constitution more susceptible of those aberrations of nutrition, of those modifications of the inflammatory process,—of suppurations and ulcerations denominated scrofula,—than of the deposition of tubercle. If we admit that tuberculous deposits on the other hand are more frequent at subsequent periods, and especially from the 20th to the 25th year, when they progressively decrease, but continue to occur long after the period at which external tuberculous affections cease to be recognized—in some instances even to the 80th year, and Laennec once opened the body of a woman who died of phthisis upwards of 99 years of age—it shews that the natural progressive changes of the blood by age, so modifies its tuberculous condition, as to lead to the deposition of tubercle, rather than the production of the various forms of scrofula. The tuberculous quality of the blood changes from infancy to age, with the natural progressive changes of that fluid. The state of the blood which leads to the deposition of tubercle is, in this point of view, but an advanced stage of the state of the blood, upon which scrofulous action is founded. At the same time, the morbid condition of the blood may advance to its last stage of tuberculization even in infancy, or it may present that intermediate state, from which results at one and the same time, tuberculous or scrofulous action and tubercular deposit. Not only the blood, but the anatomical condition of the structures, formed from and nourished by tuberculous blood, also render them more or less predisposed to tubercular deposit, according to the age of the individual.

7. The predisposing physiological causes of the manifestation of *local* tuberculous diseases at particular ages, as for instance the periods of functional activity, tending to the deposit of tubercle in the brain (p. 247), lungs, external glands (p. 226), spleen? and genital organs (p. 314), is a subject of great importance in the history of the various forms of tubercular disease; in reference to the disease of the blood, it is only important as enabling us to explain the apparent greater frequency of tuberculosis in particular periods and at epochs of life, as of cerebral diseases in infancy, phthisis in early adult age, tubercular diseases of the urinary and genital organs after puberty, &c. It affords additional explanations

of the aberrations of the effects of the law of decrement, if that law be admitted, but the predisposing causes of the local outbreak are distinct from those of the malady of the blood.

4. THE DEPRESSING PASSIONS.

Louis, and many of our best observers, have enumerated mental depression amongst the predisposing causes, and regard it as one of the most efficient. Dr. Blakiston, and others, impute to it a more specific agency in the production of the pulmonary variety of the disease. As a predisposing cause it acts upon the blood by depressing the nervous energies, diminishing the respiratory powers, disturbing the regular process of hæmatosis, altering the proportions of the constituents of the blood, and diminishing its vital properties; thereby rendering it more susceptible of the tuberculous transformation. The condition of the blood produced by long continued mental depression, is a state of poverty, analogous to that which results from many physical agencies; the effect of all these agencies may extend no further, in which case the condition of the blood constitutes simply a predisposing cause; but since, with the authors above referred to, I consider there is strong ground for the belief, that mental agencies *alone*, may actually induce the specific change in the blood which constitutes the disease; their effect will have to be more particularly enquired into in a future section. All that it is necessary to observe here is, that even should it appear that mental agencies are capable of inducing the disease of the blood in some instances, it is no less true, that in others, they may act solely in the manner above indicated as predisposing causes, their agency not having been carried sufficiently far for the production of tuberculosis.

THE PREDISPOSING PATHOLOGICAL CAUSES.

Most of the diseases, or morbid conditions of the system, in which a diminution of the red corpuscles or of the solid constituents of the blood occur, or in which the blood assumes some of the more prominent physical characters of tuberculous blood, have been regarded by pathologists as predisposing to tuberculosis. Under this head, however, statistics fail us; still there can be no doubt of the truth of the opinion in many instances.

1. *General Anæmia.*—However this may be induced by diseases other than tuberculosis—by hæmorrhage or starvation, for instance

—suddenly or gradually—and to whatever extent its effect may proceed in the production of atrophy, loss of consistence, or even the total disappearance of tissues, these effects are totally distinct from those of tuberculosis. Anæmia alone or debility, even when permanent and attended with various symptoms which contribute to the general character of tuberculosis, will not of itself produce that disease. Neither scrofulous deposits, nor scrofulous pus, nor tubercles, are found in the train of its consequences. But when an anæmic individual is subject to other and more direct causes of the disease, tuberculosis is more likely to occur than in a healthy state of the system, more especially if an individual inheriting the tuberculous predisposition or habit be rendered anæmic by any cause whatever, or become debilitated, the inherited disease is more likely to become active than if he continue otherwise in good health. Every modification of the animal economy which has a direct tendency to deteriorate and depress the vital powers of the blood and of the system generally, tends to precipitate hereditary tuberculosis, or to give effect to those agencies which are capable of producing the disease.

2. *Chlorosis.*—This affection, in which the red corpuscles of the blood attain a lower cypher than in any other disease, which comprehends all the symptoms of anæmia, and something more, the liquor sanguinis declaring by its colouring principles some additional change in the constituents of the blood, occasionally terminates in tuberculosis. When it proves fatal it is generally by the deposit of tubercle and the development of phthisis. In chlorosis, however, by far the greater number of individuals recover, whereas in tuberculosis the converse holds good. There are only a few of the characteristics of the blood in common in these two diseases, whereas in other respects it is essentially different, so that the pathogenesis of the blood in the two, differ essentially, and as respects causation, the utmost that can be said is, that the chlorotic condition of the blood, if long continued, probably predisposes to tuberculosis.

3. *Continued Febrile Action.*—The very frequent occurrence of tuberculous diseases after eruptive and other fevers, in individuals who had not previously exhibited any signs even of a tuberculous predisposition, leads to the conclusion that the blood is liable to be so changed or deteriorated by such continued action, as to become peculiarly susceptible of the tuberculous transformation. Louis occa-

sionally detected tubercles, apparently quite recent, in individuals who died after protracted typhus fever, but not so frequently as to lead to the conclusion that tuberculosis was one of the sequences of the febrile action. Manifest scrofulous disease, also, frequently occurs immediately after an attack of measles, scarlet fever, hooping cough, or erysipelas. Lugol, holding the doctrine that no combination of causes can render an individual tuberculous, who is not tainted innately or hereditarily, denies that these diseases are the causes of the tubercular affections which follow them.

We believe that the changes produced in the blood, and the condition in which the blood is necessarily left by these diseases, constitutes a predisposition to the tuberculous transformation, and that its occurrence or not, depends in a great measure upon the hygienic circumstances under which the patient is placed during the disease, and the treatment adopted, and most especially on the circumstances and treatment of the case during convalescence. Louis remarks, that none of the cases of typhus fever where death occurred early in the disease, presented tubercles; all the cases of the fever presenting on inspection tubercles at the apices of the lungs, having been protracted from 25 to 46 days after the invasion of the disease. In consequence of the excited action of a fever, as in measles, small pox and scarlet fever, the vitality of the blood is liable to be for a long time diminished. Under these circumstances a predisposition to be acted upon by the efficient causes of tuberculosis, is established in the blood, and some of the most acute forms of tuberculosis occur. The inflammatory fever which attends pleurisy, pneumonia, bronchitis, and other affections, may in like manner result in tuberculization, provided, as remarked by Louis, it has run a course of some length, and the attending febrile action has been of some severity. At the same time, the changes effected in the blood in the progress of these diseases, and the improved hæmatosis during a well regulated convalescence, under favorable circumstances, have been known to cure the tuberculous constitution, and its scrofulous and tuberculous manifestations. Cullen observed this. Rilliett and Barthez believe tubercle and small pox, and even scarlatina, to be of different natures, mutually repelling each other, and impeding rather than accelerating the progress of tubercles when formed; but, on the other hand, they refer to instances of tuberculosis occurring several years after small-pox, even where the pock marks remained. Lugol gives

examples of scrofulous glands being cured in the progress of convalescence after erysipelas. Phillips confirms the remark that scrofulous affections are frequently cured by eruptive fevers. It is readily to be believed, that during the effervescence of an eruptive fever, as the small-pox, the tuberculous constitution of the blood may be totally destroyed, and that, provided the causes which originally produced the tuberculosis are not in operation, during the renovation of the blood and the convalescence of the patient, the disease may be cured. It is equally feasible, that if a fever be protracted, and the process of hæmatosis defective during convalescence, the blood may be left in a condition predisposed to tuberculosis, and that if the more efficient causes of that disease are at the time in operation, tubercular deposits may rapidly supervene.

But the *modus operandi* of these predisposing causes is, especially, by the necessary production of a large proportion of new blood, and this new blood like that of young children, and of the earlier periods of life, is peculiarly susceptible of the tuberculous transformation. This explains a great many facts, and some seeming anomalies in the pathology and in the statistics of the disease, and it especially elucidates the analogy between many of the cases of acute tuberculosis in adults, and tuberculosis as it affects young subjects (p. 363). In individuals of the tuberculous constitution, or having that conformation and that state of the blood which marks the minor shades and degrees of tuberculosis, these predisposing causes may be all sufficient to bring the disease into activity —the debility which succeeds to an inflammatory attack in an infant of a tuberculous constitution, would be amply sufficient to precipitate that constitution into a state of active disease, and thus lead to the deposition of tubercle.

4. *Vaccination.*—MM. Rilliett and Barthez hold the opinion, doubtingly, that the vaccine disease is a predisposing cause of tuberculosis. They rest this upon the assumed fact, that since the discovery of vaccination tuberculosis has become more frequent; and upon the observation of a limited number of cases, in which children who had been vaccinated appeared to be more disposed to the disease than those who had not. They never witnessed tuberculosis immediately follow vaccination, but children who had been vaccinated died more frequently tuberculous than not, and the converse occurred among those who had not been vaccinated; thus—

Of 208 children vaccinated	. .	138 died tuberculous	. .	70 non-tuberculous
„ 95 „	not vaccinated .	30 „	. .	65 „

Nearly the same ratio as the last existed among those who had neither been vaccinated nor had the small-pox, viz., out of 61 cases, 19 died tuberculous, and 42 non-tuberculous.

I have introduced this highly-important question, although there are no statistics of the disease in this country, that I am aware of, which can solve it. Any limited number of cases, as the above, must leave it, at most, a conjecture, with some slight degree of probability.

The above instances of morbid conditions producing or leading to a state of the blood which acts as a predisposing cause of tuberculosis, might be very much extended; *protracted dysenteries* and other abdominal affections, for instance, might be enumerated, since they are very frequently succeeded by tubercular diseases; but inasmuch as most of these agencies have been regarded as true efficient causes, and will have to be treated of under the following head, the illustrations here given will suffice. As respects the predisposing pathological causes, it is to be observed, that they differ from the predisposing physiological causes, inasmuch as the modified state of the blood in the former is not in relation to the constitution generally, as in the latter; there is a disturbance of equilibrium between the constitution of the blood and the structure and functions of the tissues and organs of the economy generally, and by this we theoretically explain the fact, that with the sole exception of age, they are far more influential as predisposing causes of the disease.

The conditions of the animal economy which constitute predisposing causes of tuberculosis, are totally distinct from the "predisposition to tuberculosis," described in the first chapter. As stated in the first division of the present chapter (p. 382), these states, physiological and pathological, are all liable to be transmitted hereditarily from parent to offspring; and children, without inheriting tuberculosis or the tuberculous predisposition—that is to say, a tuberculous state of the blood, and tuberculous deterioration of the animal structures—may, nevertheless, inherit a feeble constitution or an anæmic condition, which, as true predisposing causes, may render them more liable to become tuberculous than those

who are born of healthy parents, and possessed of a vigorous constitution.

Many of those circumstances relating to parents which have been enumerated (p. 390), as possible causes of the original production of the disease in the embryo, at the period of conception, may certainly be followed by that kind of debility in the child, which I have just described as constituting a predisposing cause. The debility produced by syphilis, the long-continued action of mercury, the abuse of the sexual passions, precocious marriages, extreme age, and the like, may thus produce, by hereditary transmission, or by the primary conception of weakly offspring, a weakly state of constitution predisposing to tuberculosis.

Thus, of all the circumstances which have been assigned as predisposing causes of tuberculosis—1, *the physiological state of the blood corresponding with the earlier ages of life,*—2, *a deteriorated condition of the blood with or without an original feeble organization, and*—3, *an untimely and disproportionate renovation of the blood in consequence of disease,*—are those only to which any real importance can be attached.

B. OF THE INDUCING CAUSES OF TUBERCULOSIS.

The etiology of tuberculosis is involved in the greatest difficulties. So numerous, so different, and in many instances so contradictory are the antihygienic and hygienic influences which have been assigned as the true causes, that it is difficult to devise any principle of arrangement which will embrace the whole of them; and yet, in the absence of any demonstrative evidence of the real cause and essential nature of the disease, the whole must enter into a comprehensive view of the subject. The following pages will shew, that in a great majority of cases, if not in all, combined agencies have been in play, and that one principal difficulty consists in forming a true estimate of the etiological effects of each, regarded separately. I purpose stating the evidence upon which the etiological influence of each assigned cause is supported, and concluding with a view of the effects of these agencies in known or unknown associations.

The following programme exhibits, at one view, the principal influences, hygienic and hæmatic, internal and external, to which

tuberculous affections have been attributed by practical and theoretical writers; and is intended to comprehend all the causes of a tuberculous state of the blood—real or probable—independent of parentage; the causes of mere local disease being almost entirely disregarded:—

I. Atmospheric Agencies.

1. *Electricity.*
   - *a* A Deficiency of Atmospheric Electricity.
2. *Light.*
   - *a* The Habitual Deprivation of the Solar Rays.
3. *Caloric.*
   - *a* Exposure to too cold an Atmospheric Medium.
   - *b* Exposure to too heated an Atmosphere.
   - *c* Vicissitudes of Temperature.
4. *Oxygen.*
   - *a* The Habitual Deprivation of Vital Air.
   - *b* Excess of Oxygenation.
   - *c* Excessive Density or Rarity of the Atmosphere.
5. *Humidity.*
   - *a* Excessive Moisture of the Atmosphere.
   - *b* Excessive Dryness of the Atmosphere.
6. *Atmospheric Air.*
   - *a* The Respiration of an Atmosphere not sufficiently renewed.
   - *b* The Respiration of Air vitiated by Deleterious Admixtures.
   - *c* Specific Epidemic Influences.

II. The Alimentary Ingesta.

1. *Food.*
   - *a* Habitual Insufficiency of Food.
   - *b* Excess or Deficiency of one or more of the Alimentary Principles.
   - *c* Deprivation of the Breast Milk, or Defects in its Quality.
2. *Poisons and Medicines.*
   - *a* Poisons contained in the Food or Drink.
   - *b* The Abuse of certain Medicines.
3. *Drink.*
   - *a* Impure Water.
   - *b* The habitual use of Alcoholic Fluids.
   - *c* Excessive use of Diluting Fluids.

III. Hæmatic Agencies.

a Hæmorrhage.
b Excessive Secretions and Excretions.
c Suppression of the Secretions and Excretions.
Habits of Uncleanliness.

IV. Functional Agencies.

1. *Exercise.*
   a Excess of Bodily Labour.
   b Deficiency of Bodily Labour.
   Sedentary Employments.
2. *Sensual Excesses and Abuses.*
   a Masturbation.
3. *Mental Excesses and Abuses.*
   a Mental Excitement.
   b The Depressing Passions.

V. Pathological Agencies.

1. *Previous Diseases.*
2. *Contagion.*

VI. Combined Agencies.

1. *Prison Discipline.*
2. *Prolonged Residence in Hospitals.*
3. *Locality of Habitation.*
4. *Poverty or Riches.*
5. *Occupations of Life.*
6. *Season.*
7. *Climate.*
   a Change of Climate.

I.—Atmospheric Agencies.

1.—Electricity.

(*a*) *Deficiency of atmospheric electricity.*—A suggestion was made by Humboldt, that a diminished quantity of electricity in the atmosphere coincides with the occurrence of scrofula in certain localities. More recently M. Hirsch* appears to have arrived at

* Nouvelle Encyclo. des Sciences Médicales, Août 1850, p. 225.

the conclusion, partly from a theory of Eisenmann's, but also from observations of his own, that modifications in the electric state of the atmosphere, coincide with the occurrence of scrofula endemically in certain countries; and, admitting the essential identity of all forms of tuberculosis, that it may possibly account for the frequency of the scrofulous manifestations, and the infrequency of phthisis, which are stated to be observed in these localities. The facts, however, appear to be contradictory, and as far as they have at present been developed, do not warrant the conclusion that atmospheric electricity is concerned in the production of a tuberculous state of the blood.

At the same time, so long as the problem of causation remains unsolved, and in the actual state of science, no prudent medical philosopher will omit atmospheric electricity from the category of possible causes. The discovery, by Mr. Faraday, of the magnetic properties of oxygen,* and by M. Schönbein, of the influence of *ozone* over vaporous or gaseous matters in the atmosphere which prove deleterious to the animal economy,† are quite sufficient, as scientific facts, to induce caution on this point. The development of the theory of the *correlation of the physical forces* by Mr. Groves, and the extension of this to the theory of the *correlation of the physical and vital forces* by Dr. Carpenter,‡ viewed in association with the discoveries by Professor Matteucci of the phenomena of static and dynamic electricity in the human body, and the correlation existing between the electric current and nervous force,§ are additional reasons for including electricity in our reasoning on the etiology of a disease, which so generally affects the whole range of organized nature.

2.—LIGHT.

(*a*) *The habitual deprivation of the solar rays.*—The tuberculous constitution has been regarded as a species of etiolation, and want of sufficient exposure to the rays of solar light as a cause. In vegetables, the privation of solar light produces, or contributes with other causes to produce, a pale, sickly and etiolated state. Light as well as heat is essential to the development of the vegetable germ, and to the production and reproduction of organic cells. Something very analogous occurs when animals, and particularly

* Philosoph. Transac., 1851, part i, p. 20, et pas.

† Med. Chir. Transac., vol. xxxiv, p. 205. ‡ Philosoph. Transac., 1850, part ii.

§ Philosoph. Transac., 1850, part ii, p. 287.

man, are deprived of light for a considerable period; cell-growth and nutrition is deteriorated, an anæmic state, with a deficiency of the red corpuscles of the blood takes place, its albuminous and other constituents are imperfectly formed, all the fluids become thin and watery, the structures pale, soft and flaccid, the circulation weak, and the power of voluntary motion diminished. This state would necessarily operate as a powerful predisposing cause, but it does not constitute tuberculosis.

The influence of light has been disputed, on the ground, that in northern regions where darkness prevails for several months together, we have no proof of its effects; but this objection is unreal, inasmuch as the inhabitants of these regions are subject, upon the whole, to a very great proportion of solar light, and in the period of darkness, probably to compensating agencies, and a long period is required for the deprivation of the solar rays to produce the effects in question. It has also been objected, that tuberculous affections are sometimes very frequent in localities greatly exposed to the rays of the sun, and in individuals who have never been deprived of them.

The real difficulty in estimating the effects of light, lies in the impossibility of isolating them from those of other agencies. Even where individuals have been incarcerated for years in dark dungeons, they have also been deprived of sufficient food and exercise, and subjected to the baneful agency of the depressing passions, and the effects on the constitution have been the result of these agencies combined.

Notwithstanding these difficulties, the injurious effects of the deprivation of the influence of the solar rays on the economy of man, is manifest, and generally admitted. Light, as well as heat and oxygen, is necessary to render the materials received into the blood organizable. In man, the forces of light, electricity and magnetism, are in a great measure replaced by nervous power (Newport);* and light has even been regarded as the primary source of vital power. At all events, the probable correlation of light and vital power, taken with the obvious influence of the deprivation of light over the development of organic cells and organic structures generally, associated with the fact of a diminished number of blood corpuscles, and other evidences of defective

* On the Natural Affinities of the Oil Beetle Melöe. Annals of Natural History, October, 1850.

cell-growth, being prominent characteristics of tuberculosis (pp. 6, 20), it must be admitted that the influence of solar light may have a more close relation to the true cause of the disease, than can at present be demonstrated.

3.—CALORIC.

The only means we have of estimating the influence of caloric, the material or principle of heat, in the animal economy, is by observing the effects that result from the *temperature* to which it is subjected. The evidence before us, appears to demonstrate clearly, that modifications of temperature alone, are totally inadequate to the production of the specific change of the blood constituting tuberculosis.

(*a*) *Too cold an atmosphere.*—Cold has been very frequently stated by systematic writers to be a cause of tuberculous affections; but whether we measure the prevalence of the disease by the mortality of its principal forms, or by the actual prevalence of any particular form, we are led to the conclusion, that the utmost effect of a low temperature, is either to depress the vital energies, thereby producing a state of the system which acts as a predisposing cause of a tuberculous state of the blood, or to excite or aggravate local disease when the constitution is already tuberculous. Mr. Phillips has recorded numerous facts which shew, that populations inhabiting cold countries are not peculiarly liable to the external forms of the disease. In Iceland, Greenland and Spitzbergen, they are very rare, and in Russia less frequent than in many warmer climates; according to Colonel Tulloch's war-office returns, spread over many years, and including very large numbers of individuals, British soldiers sent to cold climates are rather less than more frequently invalided for "scrofula" than those sent to warmer climates; in Nova Scotia and New Brunswick, where the mean temperature was lowest, less frequently than in Jamaica and Sierra Leone where it was highest; and very much less frequently than in localities of a moderate mean temperature. So also, taking England and Wales, and contrasting the portions of country, south and north of the 53rd parallel of latitude, the deaths registered from "scrofula" were less in the northern district, where the mean temperature is lowest, than in the southern, in the proportion of 1 in 37, to 1 in 49.

With respect to phthisis, according to Dr. Thorstenson, who

practised in Iceland and Lapland seventeen years, phthisis is a rare disease in that country, although croup and catarrh occur frequently. Sir A. Crichton and Sir G. Lefevre state that it is much less frequent in Russia than in Britain; and other writers have described it as a rare disease in the former country;* from Crantz's history of Greenland it appears also that in this inclement climate phthisis occurs but seldom.

According to Colonel Tulloch's statistical reports of the British Army, tuberculosis pulmonalis is more frequent in the western tropical zone than in our own climate, or even the colder climate of Canada; and according to Dr. Forry's statistical researches into the records of the medical department of the American Army, throughout the whole *southern* region of North America, the proportion attacked annually averaged $10^{3}/_{10}$ per 1000 of the mean strength, and the whole number of deaths from phthisis and hæmoptysis was 118, whereas, throughout the *northern* region the average was seven annually and the whole number of deaths only 47; and in that part of the northern region where the climate is most inclement of all, the proportion attacked was but $5^{1}/_{10}$ per 1000. Comparing this with the proportion per 1000 of the British Army attacked at each of the following stations:—

Jamaica	13
West Indies	12
Bermuda	9
Canada	6½
United Kingdom	6½

it appears to be clearly established that the occurrence of tuberculosis pulmonalis, both in the British and the United States Army, is nearly twice as frequent in the southern as in the northern regions of the western hemisphere.

Fewer cases, in the proportion of 37 to 42, originate throughout the northern states during the extreme severity of their winter, than in the mild and equable winter of Florida, where the thermometer rarely falls below 50° Fahr.

In France, of 277 patients interrogated by M. Louis, 137 dated their first symptoms from the first day of October to the last day of March, and 140 from the first day of April to the last day of September.

From the Registrar General's Reports for England, it does not appear that the mortality from tuberculosis, including scrofula,

* Philos. Trans. vol. 68, p. 635—667.

consumption, tabes mesenterica and hydrocephalus, is greater in those years in which the average temperature is low; nor is it greater in the cold than in the warm seasons of the year. (Table VIII.)

These facts, taken as a whole, are sufficient to establish the point, that cold is of itself totally powerless in producing a tuberculous state of the blood.

The injurious effect of long continued or habitual cold in the human economy is, however, incontestable, and there can be little doubt that it acts powerfully as an ancillary cause, depressing the vital powers of the system, promoting the action of other causes, and necessarily aggravating the effects, where the predisposition or the disease already exists. Great difficulty is met with in any endeavour to appreciate its effects, inasmuch as it almost always operates as one of several combined agencies. It will have to be referred to frequently, in connection with moisture, deprivation of exercise, impure air, defective diet, and other reputed causes of the disease, and no correct appreciation can be formed of any of these causes in combination, without bearing steadily in mind the real influence exerted by depression of temperature.

Mr. Edwards demonstrated, experimentally, that there is a constant relation between the quantity of oxygen absorbed during respiration, and the quantity of heat produced in the animal economy; and that the faculty of producing heat is much greater in winter than in summer. A cold atmosphere is a dense atmosphere, containing more air, and accordingly, more oxygen in a given bulk. In these eminently philosophical principles we find an explanation of the adaptation of the constitution of animals to a great range of external temperature. But it must ever be borne in mind, that their full operation supposes the perfection and complete play of the respiratory organs. If any deficiency in these organs, or any natural or artificial impediment to the exercise of their functions occurs, the system, under the influence of external cold, immediately experiences its morbid effects.

In these points of view, we can readily understand, that in the coldest climates, where the lungs and digestion are sound, where there is a sufficiency of oxidizable food taken into the system, with exercise and suitable clothing, that the coldness of the atmosphere is rather prophylactic against than productive of tuber-

culosis; more especially, as the effect of cold on the nerves of sensation is to produce hunger, corresponding with the demands of the system for heat and vital force.

Conversely, we have to bear in mind the low power of producing heat incident to the tuberculous constitution (p. 103), and the consequent relative incapacity of resisting the morbid effects of cold, and we shall readily understand, that although in cold climates, as in Canada, tuberculosis may be a less frequent disease, yet the occurrence of local disease, as the deposit of tubercles in the lungs, may be more certain in individuals of a tuberculous constitution, and its progress is found to be more rapid.

By civilized man, whose customs and occupations are not always adapted to the full exercise of the function of respiration, means are resorted to for the purpose of counteracting the agency of cold, and supplying its place with artificial heat, such as residence in close, heated apartments, where too often the air is insufficiently renewed or more directly vitiated; or his occupations are carried on in a dense, cold air, without sufficient exercise to sustain the function of respiration at the necessary point. Under such circumstances, the injurious effects of cold are undoubtedly experienced, although it is difficult to appreciate them without reference to the action of the other anti-hygienic influences. The effect of the condensed state of the air in cold climates, is far more than counteracted by its insufficient renewal within doors, owing to want of ventilation and exercise; and the salutary action of the cold on the nervous system is nullified by the impossibility of reaction. In this case it would be most unphilosophical to attribute the tuberculous transformation of the blood to the cold alone; but the effect of the cold in diminishing the functions of the skin, and depressing the vital energies, must predispose the blood to the action of the true causes of the disease; and where the tuberculous predisposition exists, the diminution of the molecular actions in the blood, without any corresponding reaction, has the direct effect of precipitating the disease of the blood. The partial and general effects of cold on the external surface, under these circumstances, act also very frequently as exciting causes of the local determinations of the disease to the glands, lungs, brain, kidneys, and other organs.

Habitual Insufficiency of Clothing.—In cold climates, animals are protected with fur, and man protects himself with warm clothing, in aid of the respiratory process. The injurious effects of cold are

produced in an aggravated form by insufficiency of clothing. Although it may be less in degree, its longer continuance and its occurrence, for the most part, with the unfavourable complication of sedentary occupations or habits, or the absence of sufficient exercise in the open pure air, operate most injuriously. Habitual cold, from this cause, acts by depressing the cutaneous functions, and interfering with the process of hæmatosis, and by habitually diminishing the vital powers of the blood. There is reason to think that in combination with other causes, cold in this way has a very great influence over the production of tuberculosis. In tuberculous constitutions, where a low capacity for producing heat exists, it is a powerful agent in precipitating the symptoms; and in a prophylactic or therapeutical point of view, in cold climates and seasons, to sustain the animal temperature by external aid, will be found to be one of the most important indications.

(*b*) *Too Heated an Atmosphere.*—Habitual exposure to excessive heat has been stated as a cause of tuberculosis, but the fact that tuberculous affections are more frequent in climates with a moderate temperature, than they are either in very high or very low latitudes, is sufficient to shew that a high temperature is not of itself capable of producing the disease. The number of troops invalided for scrofula at Jamaica and Sierra Leone, where the mean temperature was the highest, according to Colonel Tulloch's returns, was 1 in 859, and 1 in 921; the average being about 1 in 600. Although, as already stated, in the western hemisphere tuberculosis pulmonalis occurs twice as frequently among the troops in the southern as in the northern states, in the British Army in the East Indies, where the frame is subjected to the highest temperature, not two cases occur among 1000 soldiers annually.

If there is any part of the globe which may be said to enjoy a comparative immunity from phthisis, it is the explored and civilized portions of Africa. In Egypt, Nubia, Syria, Abyssinia, and on the Western and Eastern coasts, according to Clot Bey, Colonel Tulloch, Dr. Southey, Andral, and other authorities, phthisis is a very rare disease indeed, notwithstanding the more elevated temperature of these climates compared with European countries, where the disease is most prevalent. If an elevated temperature alone could produce a tuberculous state of the blood, it would surely be frequent here.

Tuberculosis is, however, very frequent in other countries where

the mean temperature is very high, as in Italy, Spain, Martinique and other places. At a high temperature, the atmosphere being rarefied, proportionately less oxygen is consumed during respiration, and those who have regarded the disease as one of diminished oxygenation, have resorted to these facts in support of their doctrine; but the rarefication of the air is in relation to the diminished amount of oxygenation *required* for the support of the animal heat. At the same time, exposure habitually to too elevated a temperature produces relaxation, debility, and a weak circulation of the blood, and disturbs the appetite and digestion; and it is frequently very injurious to tuberculous individuals; so that there can be very little doubt that it produces a state of the blood which may act as a predisposing cause of the disease. I am disposed to believe, on the one hand, that a very high temperature, for a long continuance, co-operating with other causes, may assist in the production of a tuberculous state of the blood; and, on the other hand, that a certain degree of elevation of temperature is favourable to the tuberculous, as being prophylactic against the development of local disease.

(*c*) *Vicissitudes of Temperature.*—Heat and cold in vicissitudes, regular or irregular, have been frequently set down as a cause of those affections which have a tuberculous condition of the blood as an essential and primary character; but in Canada, with a range of temperature of 125°, and where a range of 52° has been experienced in 12 hours, the invaliding of the British soldiers for scrofula is less than at St. Helena, with a temperature ranging between 68° and 83°. Mr. B. Phillips concludes, after a very close examination, that it does not appear "that either a high, or a low, an equable, or a variable temperature, exercises any uniform or evident influence over the occurrence of scrofula in the British soldier."

The same may be said of phthisis, it occurs with nearly equal frequency in the most variable and the most equable climates; in Australia, which is subject to great variations of temperature, phthisis is comparatively a rare disease (Lang); and of tuberculosis generally, it may be stated, that its occurrence appears by no means to be influenced by variability of climate; although in debilitated and tuberculous subjects, sudden changes of the atmosphere frequently lead to the production of local diseases, and aggravate in a very marked degree those which already exist.

In estimating the effects of atmospheric changes, it is to be

noted, that those individuals most exposed to them are not always those who are most likely to be injuriously affected; in the coldest climates, the inhabitants are generally fortified against the injurious operation of such influences, by the adaptation of diet, clothing, and other circumstances. Infants, and very young children, suffer most perhaps from exposure; old people suffer more than young people generally, but they are more careful to avoid its effects; individuals whose constitutions are feeble and circulation languid, and especially the tuberculous, are very obnoxious to the morbid effect of atmospheric vicissitudes; and the inhabitants of towns, being less exposed to the open air and atmospheric changes, suffer comparatively more from the exposure than country people.

4. OXYGEN.

1*st. The habitual deprivation of Vital Air.* — It cannot be affirmed, that any philosophical investigation of the influence of air in the production of disease, has hitherto been made, either as respects its oxygen or its carbonic acid, or its nitrogen gas. Most of the enquiries relating to the influence of the atmosphere as a cause of tuberculous affections, relate to the more complicated consideration of the effects of a vitiated or poisoned atmosphere. The distinction has rarely been made, between the effects of a deficiency of the natural elements of the air, and the effects of inspiring impure air, nor do writers agree, as to the degree of disturbance of the relative proportions of the constituent parts of the atmosphere, to which importance ought to be attached. Thus, Mr. Phillips quotes an experiment made in the Chemical Amphitheatre at the Sarbonne, in which, during an hour's lecture by M. Dumas, there being 900 persons present, the change in the proportion of oxygen in 1000 parts of dry air, amounted to 4·7 parts, which he regards as no very great modification. But when we consider the provident care of nature, in preserving the exact uniformity of the atmosphere, in all localities, by the law of the diffusion of gases, it appears to us, that this ought to be regarded as a very great deviation from the ordinary proportions. Of the effects of such a change of the atmosphere, if continued for any length of time, on the pabulum of renovating blood—conveyed into the circulation in the form of lymph and chyle—during its transit through the lungs, we know nothing; but when we consider, that the essential constituents of chyle, as the albumen, are definite compounds, and that the transformations

which the materials of the blood undergo in the process of hæmatosis are in definite proportions, the combining numbers being very high indeed, moreover, that there is every philosophical ground for the belief, that the ordinary proportions of the atmosphere are exactly adapted to preserve the air resident in the chest in the condition essential to the change from chyle to blood, it is by far more reasonable to infer that any change of these proportions, even to a much smaller extent than indicated in the above experiments, if of long continuance, is likely to modify the whole process of sanguification.

It has generally been laid down as a principle, that no difference can be detected in the proportions of the essential constituents of the air, whether obtained from the summit of Mount Blanc, the level of the Sea, at the Equator, the Polar Circle, in the country, or in the most crowded districts of the most populous cities; yet the experiment just quoted, proves that these proportions may be disturbed, and we cannot doubt that disturbances occur in a minor degree without being detectable by analysis. The infected atmosphere which produces fever, ague, probably cholera, and other diseases, give no indications to the chemist, of the nature of the modifications, nor of the substances combined or mixed therewith; but the breathing of a confined atmosphere for many hours, as in a close cabin, or an ill-ventilated bed-room, is undoubtedly the breathing of an atmosphere in which the normal proportions of its constituents are more or less changed.

Baudelocque maintains, that a change in the proportions of the constituent principles of the atmosphere which supports respiration has a decided influence over hæmatosis, but his observations, as well as those of Hufeland and Phillips, do not specially refer to the effects of a deprivation of oxygen, but rather generally to the vitiation of the atmosphere; which may result from an excess of carbonic acid, or the admixture of foreign materials, or from the combined influence of several of these changes; they accordingly merge in the considerations embraced in another section.

I have already stated, in the symptomatology (p. 98) that the function of the lungs, so far as oxygenation is concerned, appears to be completely performed; but whether a deficiency of oxygen or an excess of nitrogen or of carbonic acid gases, in the air habitually respired, has any direct influence in the production of the specific modification of the blood which constitutes tuberculosis, must be

regarded as a question which has not hitherto been submitted to scientific investigation.

(*b*) *Excess of Oxygenation.*—Shortly after the discovery of the composition of the atmosphere, it was maintained by Dr. Beddoes and others, that phthisis depends essentially upon super-oxygenation of the blood. The opinion appeared to be sanctioned by the brighter colour of the blood frequently noticed in the course of the disease, and by some of the symptoms of hectic fever; but all the observations I have been able to find, apply to phthisis as a local disease of the lungs, and by no means to tuberculosis as a disease of the blood.

(*c*) *Excessive density or rarity of the atmosphere.*—We have not sufficient facts to determine the influence of increased or decreased pressure of the atmosphere in hæmatosis. Assuming the amount of oxygen required by the system as a fixed quantity, and the greater the pressure and density the greater the quantity of oxygen in a given bulk of air, a diminished number of respirations should correspond with a rise in the barometer, and such is found by observation and experiment to be the case. A highly rarefied atmosphere affects the respiration in an opposite manner, rendering it feeble and frequent, and producing dyspnœa, with quickness and weakness of the pulse; and in a moderately condensed atmosphere, the breathing is easy, the capacity of the lungs appears to be enlarged, the respirations are deeper and less frequent, digestion is more active, and the whole of the vital energies are increased. We here see a correspondence between the effects of too rarefied an atmosphere and the symptoms of tuberculosis, but we have no data before us by which to determine whether the continued influence of a rarefied atmosphere in a minor degree, dissociated from other qualities or agencies, has any effect in producing a tuberculous state of the blood.

At an elevation of from 15,000 to 16,000 feet above the level of the ocean, as in some regions in Asia and America, where the density of the atmosphere is diminished one half, animals and man live and breathe, and we have little evidence of their being more or less subject to tuberculosis. In M. D'Espine's and Lebert's investigations in the Cantons of Geneva and Vaud, scrofula and phthisis appeared to be as frequent in the villages and hamlets on the heights, as in the vallies of the Alps; but in Dr. A. Smith's experience in Peru, patients were cured of phthisis

by sending them from the city to a situation on the Andes, elevated 8 to 10,000 feet above the level of the ocean.

The subject of the pressure and density of the atmosphere, can be thoroughly investigated, only as a part of the complicated subject of the influence of climate over disease.

5.—HUMIDITY.

(*a*) *Too moist an atmosphere.*—In order to understand the question of the influence of a humid atmosphere in relation to the production of tuberculosis, the effect of such an atmosphere on the animal economy generally must be taken into account. 1. It is quite clear, that if the body be habitually surrounded with an atmosphere surcharged with aqueous vapour, there will be less evaporation from the lungs and skin, and, *cæteris paribus*, the blood will be more aqueous; a kind of serous diathesis may be established in this manner. The means by which this hydroæmic tendency is moderated or prevented, are by a diminution of thirst, and of the fluid ingesta, a vicarious action of the kidneys, or both. 2. The conversion of fluids into vapour is a cooling process, so that a humid atmosphere, by diminishing the vaporous exhalation, has a tendency to maintain the blood at an elevated temperature. 3. In a moist atmosphere the elastic force of the vapour displaces a portion of the air, and diminishes its respiratory qualities; and although, even at the point of saturation, the amount of this effect is but trifling, in connection with the other effects of a moist atmosphere, it ought not to be overlooked.

It is generally true, that external tuberculosis is very common in humid countries, but it is certain that it occurs also very frequently in dry localities; and there are very humid places in which it is scarcely known. M. Baudelocque gives some remarkable examples of both these circumstances.

Mr. B. Phillips ascertained that of 1,193 deaths from "scrofula," in England and Wales, in the year 1841, compared with the population for that year, and the deaths in particular comparatively wet or dry districts, compared with the population of the same districts,—

The deaths in	England and Wales	to the population	were	1 in 13,400
,,	five dry countries	,,	,,	1 in 10,500
,,	five damp ,,	,,	,,	1 in 10,300
,,	sea-side towns	,,	,,	1 in 12,500
,,	inland towns	,,	,,	1 in 13,250

In London the deaths were more numerous on the banks of the Thames than at Shoreditch, Bethnal Green, Whitechapel, or Marylebone, in the proportion of 1 in 365 to 1 in 762.

It cannot, as I conceive, be too forcibly insisted on, that the number of deaths from scrofula, or the frequency of scrofula, is no accurate measure of the frequency of the constitutional disease. In two localities where the inhabitants are equally liable to tuberculosis, the one, possessing a damp atmosphere, may present more cases of external tuberculosis than the other, possessing a dry atmosphere; and the only influence of this particular state of the air may be to promote this particular localization of the disease.

As respects tuberculosis with the internal deposit of tubercle, in 525 tubercular and non-tubercular children, Rilliett and Barthez ascertained as follows:—

	314 Tubercular.		211 Non-tubercular.
Resided in damp localities .	43	..	21
„ dry „ . .	107	..	65
Information incomplete . .	164	..	125

Many authors, as Lombard and Louis, have held, that a moist atmosphere is preservative against phthisis—especially a *mild, equable* and *moist* climate; and this opinion has been so generally received, as to be very commonly acted upon in the selection of a climate for the consumptive invalid. From this, however, it is evident that a moist atmosphere requires to be considered in two points of view, as associated with a high or low temperature.

A *moist and warm* atmosphere has been suspected of being a cause of tuberculous affections; but in Picardy, which possesses just such a climate, external tuberculous affections are said to be only prevalent among those whose occupations confine them within doors. (Baudelocque.)

A writer in the *Medical Gazette* attaches very great importance to a damp atmosphere in the production of tuberculosis (vol. 30, p. 295). Supposing a climate, he remarks, possessing an ordinary temperature of 100° Fah., saturated with moisture, and the blood circulating through the lungs at 100°, there would be a complete arrest of evaporation from the lungs. Dr. Prout entertained the notion, that the evaporation of the water from the chyle, as it passes through the lungs, contributes to the conversion of the incipient albumen of the chyle into the perfect albumen of the liquor sanguinis; and the writer just referred to brings facts to shew, that the arrest of this part of the function of the lungs is

one of the causes which tends to produce phthisis. In tropical countries, the writer proceeds to state, where the temperature is very high, and the atmosphere nearly saturated with moisture, the disease is very frequent; on the other hand, where the climate is dry the disease is infrequent. In Egypt, the atmosphere is warm, extremely dry, and tolerably equable—in Australia, the atmosphere is temperate, but extremely variable, and very dry—at the Cape of Good Hope, and especially the Eastern frontier district, the temperature is high, extremely variable, and the atmosphere very dry—in all these countries phthisis is a very rare disease. In the Antilles, the temperature is high, its extreme range small, the barometrical pressure high and but little variable, and the air is damp—in Bermuda, the temperature is moderate, very equable, the density of the air very considerable, but subject to little variation, and the quantity of aqueous vapour diffused very considerable—at Gibraltar, the temperature is moderate, and not very variable, but owing to the great frequency of the Levanters or Easterly winds, blowing over the arid sands of Africa, and then over the Mediterranean, it is very damp. In all the latter countries, according to the Army Medical Reports, and other authorities, phthisis is very common. This writer also attempts to shew, that according to the degree of dryness or moisture, and totally independent of temperature or variability, is the disease more or less prevalent. Madeira has a drier climate than England, but is by no means so dry as those just named, and in accordance with its medium degree of moisture, is phthisis more frequent than in Egypt, or the Cape of Good Hope, and less frequent than in London.

On the other hand, there is a vast amount of evidence extant, ostensibly to prove, that *cold and damp* are the causes of tuberculous affections; but unfortunately, the greater part of it is vitiated by these etiological influences being combined with others, and by the observers neither having taken this into the account, nor distinguished between the causes of the constitutional disease and those of the local determination of the disease. According to Roesch, Marchand, and other writers, humidity plays an important part in the production of scrofula, and especially of *cretinism*, which are found in valleys and low places, abounding in fog and moisture, exposed to sudden changes of temperature, being often very hot in the middle of the day and cool or even cold in the morning and evening; whereas they are never endemic

in plains and elevated *plateaux*.* So also Dr. Pickering observed consumption in the Malay race, in the humid climate of Hilo (Hawaiin Islands); but at the same time the food of the natives of these islands appears to be very defective: "They are content with a little fish and a little *poi* (prepared taro—Colocasia esculenta." † M. Jolly, by a report to the French government on the sanitary condition of Landes, a cold, damp, marshy district, found external tuberculosis very prevalent.

Baudelocque, admitting the facts, disputes the etiological influence of cold and moisture, on the following grounds:—1. The cold and moist air acts indiscriminately on the inhabitants of a country or town; and yet the disease prevails more in particular localities than in others, shewing the influence of some other cause. 2. In cold and humid countries, it is not always in those localities where these unfavourable conditions exist in the highest degree that the greatest number of cases occur. 3. Among artizans and labourers residing in a cold and humid country, it is not those who are most exposed to the inclemencies of the weather, the cold, moist atmosphere, and the rain, who are most subject to the disease; but those whose occupations confine them within doors, and who protect themselves most sedulously from the influence of the climate. 4. Infants kept within doors are more liable to be affected than those who are freely exposed. 5. Animals in cold and humid climates not natural to them, kept in warm places and protected from the influence of the cold and moisture, more frequently become tuberculous than those which are freely exposed.

Theoretically, I do not think it feasible, that the moisture of the atmosphere can be in any way essentially connected with the production of a tuberculous state of the blood. If Mr. Phillips's statistics shew, that humidity exercises a small, though certain influence, in producing external scrofula, this proves only that it influences the determination of the disease. The statements quoted from the writer in the *Medical Gazette* are certainly most important, and their value would be greatly enhanced if correct statistics of the humidity of the atmosphere in the various localities, over a sufficient period, with broader statistics of the relative frequency of all forms of the disease, and an account of

* Gal. Med. de Strasbourg, Nov. 1842.

† Pickering's Races of Man; Bohn's ed., pp. 86, 97, 419.

the sanitary condition of the localities in other respects, were extant. Bermuda, for instance, instead of possessing a very equable climate, according to Sir J. Clarke, (l. c., p. 305) is variable, and subject to great and rapid changes. As we proceed, we shall find that there are other causes, which rest upon more complete evidence, to which the disease is attributable. At the same time, looking at its effects on the blood and on the whole economy, there can be no doubt that an excessive degree of humidity, especially in combination with cold, acts as a powerful auxiliary to other more efficient causes, in many instances, and is frequently highly injurious. It may not be out of place here to remark also, that this question of the etiology of tuberculosis, is quite distinct from that of the treatment of confirmed tubercular disease of the lungs, and that the effect of the humidity or dryness of the atmosphere, in relation to the latter, rests upon other grounds, and requires to be considered separately.

(*b*) *Excessive dryness of the atmosphere.*—Tuberculous subjects have sometimes been benefitted by a change of residence from a dry to a moist locality, and this has given rise to the opinion that a dry atmosphere has had something to do in the causation. The effect has been chiefly observed in the subjects of the pulmonary variety, and the consideration of it belongs to the local affection, rather than to the constitutional disease.

Of the importance of a due degree of moisture in the atmosphere, to the health of all organized beings, animal or vegetable, there can be no doubt, and it is much to be regretted, that science has not at present determined the true sanitary range for man, of the moisture of the atmosphere, in reference to temperature and pressure. We know well, that a very cold or a very hot atmosphere, with extreme aridity, and especially with winds or currents, is injurious, in this climate, to the respiratory surfaces, and perhaps primarily to the healthy constitution of the blood. We have abundant evidence also, that an atmosphere artificially heated and rendered too dry has analogous effects. Palpable facts have proved that this state of atmosphere frequently operates injuriously on tubercular lungs, but there is no evidence whatever to shew that it produces tuberculosis. It will appear under another head, that the epidemic diseases which occur in such a state of atmosphere, as influenza, are in no wise productive of the disease, however injurious they may at times prove to the tuberculous constitution.

6.—VITIATED ATMOSPHERIC AIR.

The expression "a vitiated atmosphere" has frequently been employed indefinitely; it is generally understood as one in which not only the quantity of oxygen gas is diminished, and the quantity of carbonic acid gas increased, but which contains impurities, detectable or not by the instruments of science. Hufeland adds humidity and cold to his definition, and such an atmosphere he considers the prolific source of scrofula. Most writers on tubercular diseases, ancient and modern, have attached very great importance to this as a cause; but more recently statistics have been appealed to, especially by Mr. B. Phillips, casting a doubt over, but by no means disproving its reality. I shall state both sides of this question as fairly as I can, and conclude with my own views on the subject.

(*a*) *The respiration of an atmosphere not sufficiently renewed.*—Baudelocque, of all other writers, has the most insisted that a vitiated atmosphere is the true and probably the sole cause of tuberculosis. His doctrine is, that wherever "scrofula" exists, a vitiated atmosphere also exists, wherever there is a vitiated atmosphere there is also scrofula, and where the air is pure the disease is unknown.

Let us first determine what M. Baudelocque means by a "vitiated atmosphere." After referring to the vital properties of the air, he remarks, that whenever a portion of the atmosphere becomes isolated, respiration rapidly changes the proportions of its constituent principles, and it is gradually rendered less suitable for hæmatosis. In another place he defines it as "an atmosphere not sufficiently renewed."

Although M. Baudelocque admits that air thus vitiated yields to the blood an insufficient quantity of oxygen, and in the actual state of science it appears that this may be regarded as the cause of the evil, yet he attaches little importance to this explanation. The capital point with him is to demonstrate that the disease depends upon the respiration of air not sufficiently renewed. For this and other reasons, which will develope themselves as I proceed, the subject is treated of in this place rather than under the head of "a deficiency of oxygenation."

I now proceed to state, what appear to me to be the strongest reasons urged by M. Baudelocque in support of his doctrine. The poorest classes of the people generally, inhabiting the worst parts of

almost all large cities and towns, most frequently residing in low, humid, confined and ill-ventilated, dirty habitations, little penetrated by the sun's rays, with numerous individuals crowded together in small compartments, (undoubtedly breathing an atmosphere vitiated in the sense here understood) furnish a very large proportion of tuberculous subjects. Many of the better classes of society, as tradesmen, merchants, clerks and others, are frequently not much better off than their poorer neighbours, as respects the purity of the air they habitually breathe; they frequently pass the whole day in-doors, confined to shops and warehouses, often encumbered with merchandize; they for the most part sleep in apartments so confined, that after a period of seven or eight hours, the proportions of the constituent principles of the atmosphere are changed, under which circumstances, even if themselves comparatively healthy, their children, although sufficiently nourished, well clothed and properly taken care of, and without any trace of hereditary acquisition, frequently become rapidly tuberculous. If children, M. Baudelocque remarks, are sent for three or four hours daily into the open air, this does not prevent the pernicious effects of the bad air they breathe during twenty out of the twenty-four hours.

M. Baudelocque, with M. Kortum, whom he quotes very largely, attaches the greatest importance to the air respired during the night, which has frequently been overlooked in the discussion of this question. While White and some others have attributed the disease, in children, to too much sleep, he states that it is neither the excess nor the want of sleep, but the respiration of the air, modified by the respiratory process, which becomes injurious. Respiration being constant—not to be suspended for an instant—several persons sleeping together in a small closed apartment, probably with curtains around their beds, rapidly deteriorate the atmosphere, and change the proportions of its constituent parts, during the greater portion of the night the lungs are supplied with air becoming gradually more and more vitiated, and the process of respiration must be imperfect.

To account for the children of the richer classes becoming tuberculous, who are well nourished and taken care of, who reside in large houses situated in the most salubrious parts of cities and towns, and sleep in well ventilated apartments, it is remarked, that many gratuitous suppositions have been resorted to, but no

satisfactory reason has ever been given. Some have referred the disease to an internal vice, "so much the more deeply hidden as it is impossible to demonstrate it," others have fallen back two or three generations—direct or collateral—to discover some presumptive evidence of hereditary transmission, or have referred it to the syphilitic poison imbibed two or three generations previously. The real cause is to be found in the bed chamber, which after all is not sufficiently ventilated; and the effects of the confined atmosphere are frequently augmented by the habitual position and manner of sleeping. Many children sleep with their heads buried under the clothes, or surrounded with curtains, so that throughout the greater part of the night they must respire the same air, and it is easy to understand how rapidly and completely vitiated that air must become.

To account for the occurrence of the disease in the country where the air is pure, or rather, in villages and small towns, M. Baudelocque refers to the construction of the habitations of the poor, which are devised in the best manner possible to promote the vitiation of the air and to render ventilation difficult. The huts of the peasantry in all countries are small, low, with very little provision for light, and generally inhabited by a great many persons. Although country labourers are nearly all day in the open pure air, they are closed within ill ventilated apartments for eight hours or more out of the twenty-four; and perfect respiration is as indispensable by night as by day. "During a third of their time they respire air which does not contain the necessary proportion of that principle without which hæmatosis is impossible. It is not necessary for a person to breathe a vitiated air continually, in order to engender scrofula; if he pass only a few hours daily in such an atmosphere it may suffice. Six to eight hours out of the 24 in a narrow ill ventilated cabin may produce the disease in the shepherd, who breathes the open air all the remainder of the day. The effect is infinitely greater, if, instead of working in the fields, the peasant follows a sedentary occupation within doors; as in the case of tailors, shoemakers, the workers in factories, and to a great extent the wives of the peasantry generally."

The scrofulous forms of tuberculosis are frequently *endemic*, which is accounted for on the principle that independent of habitation, occupation, and habits of life, the disease is attributable to the want of change, and accordingly of purity in the air itself.

M. Baudelocque attaches much importance to *winds* in the change and purification of the atmosphere, and thinks too little importance has been attached to this circumstance. The localities in which, more especially, the disease is endemic, are the valleys of mountainous countries, or the gorges and narrow passages formed by the approximation of high mountains, where the air is constantly *stagnant, humid, warm* and *corrupted;* and in other situations where it is renovated with difficulty; thus, the entrance of a valley or street is only occasionally in the direction of the wind, and at all other times the renewal of the air depends upon the interchange with the purer air above. In support of his views, M. Baudelocque makes the important practical remark, that the renewal of stagnant air is by no means so easy a matter as at first sight would appear; winds and currents are absolutely necessary that it may be rapid and complete; and the remark is applicable to streets and houses as well as to villages and mountain gorges.

These are M. Baudelocque's views generally. I have omitted individual instances, as there can be no doubt that he has been misled into exaggerated statements in one or two cases. But Mr. Benjamin Phillips in this country, and MM. Rilliett and Barthez and M. Lebert in France, dispute the etiological influence of a vitiated atmosphere, supporting their opinions also by an appeal to facts.

Mr. Phillips gives statistical details, tending to prove, that a vitiated atmosphere has much less influence over the general health and mortality of a population than is supposed, and that scrofula, in particular, is more prevalent in rural districts, where the air is supposed to be purest, than in towns. It is even in many instances more prevalent in the better and more thinly populated parts of towns than in the denser districts, and thus the vitiation of the atmosphere appears to have little or nothing to do with the production of the disease; he lays great stress upon the fact, that the air found in crowded lodging-houses in the worst parts of cities, however unpleasant to the sense of smell, is not found to have undergone any *very decided* change in its ordinary elements, or to have acquired any new element cognizable by chemical examination (Lib. cit., p. 197), and he makes use of the argument, that 20 per cent. more boys than girls die of scrofula, although girls are more exposed than boys to the effects of crowded rooms and exclusion from out-door employments.

In refutation of Baudelocque's opinions, Lebert also refers to the great frequency of scrofula in the cantons of Vaud and Geneva in Switzerland, where the air is very pure and the hygienic conditions of the population most favourable, not only so, but these cantons present the greatest geographical contrasts, from the meridional vegetation of the plain, to the temperature of Norway and Sweden in the highest alpine vallies; and from the alluvial soil on the banks of the rivers, to the primitive formations of Gneiss on the frontiers of La Valais. The population consists also of agriculturalists, cultivators of the vine, and manufacturers; pauperism is less general than in other parts of Switzerland, or even in any other country in central Europe; yet, under all these favourable circumstances, scrofula is not only more frequent than theory would lead us to expect, but it is even more frequent in *some* of those localities, and amongst classes of the population where it would be the least expected, as in the inhabitants of the mountains and in mountain plains.

In the objections which are urged against Baudelocque's views no distinction has been made, again, between the exciting causes of local disease in tuberculous subjects, and the inducing causes of the constitutional disease. The tables contained in this work, drawn from the broad statistics of the general registers, (Table XIX), shew clearly that, as measured by the mortality, external tuberculous affections occur more frequently in males than in females, but they also shew, that in so far as a difference exists in reference to sex, the constitutional disease is more frequent in females than in males, which reverses Mr. Phillips's argument. Where the causes of external disease are absent, the girls more frequently live on, although their blood, from hereditary taint or the operation of a vitiated atmosphere and other influences, may be gradually becoming more tuberculous; and it is only in more advanced life, when new causes of the local development of tuberculosis in other organs are brought into play, that they in their turn, frequently contribute in a greater proportion to the mortality. Even Mr. Phillips admits that the mortality from tuberculosis, including phthisis, scrofula and tabes mesenterica, is larger in towns than in country districts.

In the absence of comparative barometrical, thermometrical and hygrometrical observations, and of statistical records of the forms of disease implied, I am also disposed to attach the less importance

to M. Lebert's objections; for instance, the influence of a rarefied atmosphere in mountainous districts must be taken into the account; also, the specific gravity of watery vapours being so much less than that of air, mountain villages are not more exempt from moisture and the impurities which moisture conveys, than the towns in the vallies; the ages and the classes of persons affected ought also to be known; but that the qualification of these objections, which I think essential, may be understood, I will now state more in detail my own view.

The view I entertain on the subject differs both from M. Baudelocque's and Mr. Phillips's. In the first place, regarding the true process of respiration as taking place between the blood, on the one hand, and the air within the cavity of the chest, on the other, this air consists of—1; the residual air—2; the air received from without by respiration; hence, it must always consist of a portion of carbonic acid gas, a portion of nitrogen gas, and a portion of atmospheric air, blended together by the law of the diffusion of gases. It is essential to life that this mixed residual air should contain a certain proportion of vital or atmospheric air, and the proportions are so rapidly changed by the blood that its continual renewal is absolutely necessary.

M. Baudelocque regards the respiration of an atmosphere not sufficiently renewed as the sole cause of tuberculosis (scrofula). Giving this expression its true interpretation, it means, that the air within the chest, by which the true process of respiration is effected, contains habitually a larger proportion of carbonic acid and nitrogen gases (irrespirable air), and a smaller proportion of oxygen gas (respirable air), than is consistent with the due reaction of the blood. The whole case is argued to prove that the vitiation of the *external air* produces the disease, but obviously this can only operate by vitiating or altering the proportions of the air within the chest.

Admitting the force of the facts brought forward in support of M. Baudelocque's doctrine, not only by himself but by many continental observers, there can be no doubt that this doctrine, as he has propounded it, is invalidated by the facts appealed to by M. Lebert and others, which has led to the etiological influence of a vitiated atmosphere being disputed altogether.

But let us take the subject in the point of view just set forth—viz: the true cause of tuberculosis is a deterioration or modifica-

tion of the proportions of the constituent principles of the air habitually contained within the chest. According to this view, the vitiation of the external atmosphere, as described by M. Baudelocque, may be truly a cause of the disease, but not the sole cause. Any other circumstance, any of the non-naturals of Hippocrates, capable of deteriorating or altering the proportions of the constituent principles of the air habitually contained in the chest, may also prove causes. In this manner, sedentary occupations, mental affections, and other influences, by retarding the pulmonary circulation and diminishing the force and frequency of the respiratory movements, may produce the disease by *vitiating the air;* and an individual, or a community, breathing the purest atmosphere on the surface of the globe, might become tuberculous.

However remarkable, it will appear clearly under future heads, that several of the circumstances which have been assigned, upon the authority of the best observers, as the most probable efficient causes of tuberculosis, have a direct effect in thus deteriorating the *material* of the respiratory process.

Of all the causes suggested as capable of producing a tuberculous state of the blood, I believe that a vitiated atmosphere, in the sense adopted by M. Baudelocque, is one of the most frequent and effectual; but I do not believe it, especially in the restricted sense, to be a sole cause. Rilliett and Barthez ascertained, that a vitiated atmosphere possesses a great influence over the development of internal tubercle in young persons; of 57 children subjected to it, 40 died tuberculous and only 17 non-tuberculous; but on the other hand, tuberculosis develops itself very frequently in children independently of this cause, for of 173 who had not been under the influence of bad air, 101 died tuberculous and 72 non-tuberculous; so that a vitiated *external* atmosphere had a real influence over the production or development of the disease, but it was not a sole cause; a result which we might have anticipated even from its unquestionable hereditary character. In a school at Norwood containing 600 boys, scrofula prevailed extensively, and great mortality occurred, which was ascribed to bad and insufficient diet. Dr. Arnott was called in to investigate the facts, and found the food good and sufficient, but the ventilation extremely defective; and this being properly remedied, the excess of scrofula speedily disappeared.* The effect of a vitiated atmosphere as one of

* Clark on Climate, p. 74.

several combined agencies will have subsequently to be considered; but I believe that many of the anomalies and apparent contradictions in which this subject is involved will be explained away by adopting the distinction which I have endeavoured to draw, in this work, between the exciting causes of local disease and the inducing causes of the constitutional disease; and by bearing in mind, that a vitiated external atmosphere, is only one of the causes by which the air employed in respiration is deteriorated, and the normal respiratory proportions of its constituent parts changed.

In thus assigning the highest etiological influence to an abnormal condition of the air habitually contained within the chest, it would be most unphilosophical to assume without proof that the effect on the blood is produced, for instance, by excessive or defective oxygenation or decarbonization; our present knowledge of the chemical constitution of tuberculous blood and of tubercle (pp. 7, 143) affords us no certain information of the true nature of the change effected.

(*b*) *The respiration of air vitiated by foreign deleterious admixtures.*—There are, absolutely, no facts to prove any relation between air vitiated in this sense, and the occurrence of tuberculosis.

(*c*) *Specific endemic influences.*—Consumption, and other tuberculous diseases, having been observed to become more frequent after certain epidemics, it has been sometimes held, that the causes of these epidemics, are also, the direct causes of tuberculosis. Science furnishes absolutely no facts to establish such a principle of causation; but since there is very great reason to believe, that the pathological processes which attend certain diseases, frequently lay the foundation of a tuberculous state of the blood, the effects of previous diseases, including some epidemics, will have to be referred to again under another head.

II.—THE ALIMENTARY INGESTA.

1.—FOOD.

Sir James Clark, Dr. Todd, and other modern pathologists, have dwelt much upon insufficient or unwholesome diet, as a cause of the predisposition to phthisis, and Mr. B. Phillips appears to go almost as far in his advocacy of deficiency of food being the cause of scrofula, as Baudelocque does to prove that the habitual deprivation of pure air is the cause.

Nearly all the investigations which have been entered into on diet, as a cause of this disease, have reference to the food as a whole, and the question of insufficiency of nutriment. Dietetics, as a science, has made considerable progress of late years, although the improvements have been comparatively little applied in general pathology and therapeutics. Prout clearly defined certain staminal principles, but where diet is mentioned in relation to the causation or cure of disease, how little are these principles questioned or regarded? If there be sufficient reason to consider defective diet as a cause of a tuberculous state of the blood—is it a deficiency as a whole, or of one or more of the essential staminal principles, or is it a defect of composition in either of these principles?

Of the varieties of diet to which the disease has been referred—defective breast milk—a superabundant proportion of farinaceous food—excess or deficiency of azotised food—too aqueous or mucilaginous a diet—aliments containing too much or too little fat—the use of salt or of excitants, as spices—have been mentioned, although little investigated. No observer has furnished us with any evidence that any particular diet, defective or vitiated, or the excess or absence of any alimentary principle, is capable alone of producing the disease; although, in truth, the attention paid to the subject of late years has been such, that if tuberculosis depended upon any special modification of diet, I think it could not have failed to declare itself. Taking the subject as I find it generally treated of, it arranges itself under the following heads:

(*a*) *Habitual insufficiency of nutriment, or food of bad quality.*—The frequency with which consumption and other tubercular diseases occur where defective and vitiated nutriment has been habitually taken, shews clearly that the kind of diet must often exercise an important influence on their production. Mr. Phillips observes, that the seeds of that deterioration of the bodily frame, which predisposes to scrofula, are sown in infancy or early life, and I collect from the whole of his statement, that he believes the particular mode in which infants are fed is the main cause of scrofula, and if it be so, I infer that it is the main cause of tuberculosis. When the unnatural feeding, to which children are so frequently subjected, does not destroy life, in the opinion of this author, it leads to the development of scrofula. Bringing up by hand, more especially, deranges nutrition, and adapts the constitution for the deposit of scrofulous matter; but he points to no

particular kind of diet as capable of producing this result; he founds his opinion upon a wide series of statistics, from which it appears that scrofula, according to his definition of the term, is most frequent among those who are ill fed, in every district and in all countries.

Mr. Phillips's illustrations are mainly as follows:—The mortality from scrofula in infant institutions, where children are brought up by hand, is unusually large; as instanced in the great factory towns of England, where the system of bringing up children by hand is most commonly practised, and where its evil effects are most apparent—first, in the great destruction of infant life—and failing that, in the development of tuberculosis. The deaths registered as from "tuberculous and scrofulous" diseases during the first year of life, in these towns, being as 1 to 31 of the total deaths, whilst in the metropolis they are 1 to 42; and during the whole of life, as 1 to 5·6 in the factory districts, and 1 to 6·4 in the metropolis. The proportion of cases of scrofula in poor districts, where want of proper food is the great privation to which the people are subjected, is unusually large; in some such districts marks of scrofula prevailing to the extent of 72 per cent., and in others, less poor, similar marks not being found in more than 11 per cent. of the population; a change in the single element of food in these districts being sufficient to arrest the progress, and in some instances wholly to eradicate the disease. Of the children in union workhouses, 9342 in number, 23 per cent. presented marks of scrofula; whereas of the children in the same districts, living at their own homes, or in institutions other than poor houses, 22,704 in number, 37½ per cent., a much larger proportion, had marks of scrofula; comparing the union dietaries with the food of the agricultural labourer, the workhouse child is better fed than the child reared in the cottage of the peasant; and when it is considered, Mr. Phillips remarks, that many of the pauper children are received into the workhouse when suffering and destitution have probably developed disease, and have almost certainly produced debility, the comparison is even less favourable for the child of the independent labourer. From the observation of Dr. Baly, in the Millbank Penitentiary, the thinnest convicts, and those having the largest proportion of unhealthy and scrofulous individuals amongst their number, came from the Scotch prisons, in which the diet consists of a sparing allowance of vege-

table and farinaceous food. In the Deaf and Dumb Asylums of London and Paris, a considerable proportion of the children are scrofulous, and a very generous diet is found necessary to maintain them in health; this has been admitted everywhere, and according to Mr. Watson, superintendent of the Deaf and Dumb Asylum in London, where children leave the asylum "to be apprenticed, or return to their friends, a large proportion get into ill health and die, in consequence, as he conceives, of their being worse fed and clad than they were when resident in the institution." According to the Registrar General's tables, the deaths from scrofula in four years in England and Wales bear the proportion of 7·6 to 100,000 deaths; but in certain districts—Great Yarmouth, Caernarvon, Rye and Bath, Whitney and Chipping Norton, Plomesgate, Melksham and Bradford—where poverty was at work with its attendants, cold and hunger, there were 18 in 100,000 deaths from the same disease. Scrofula is less prevalent in this country than it was formerly, and Mr. Phillips brings forward facts to shew that there has been a corresponding improvement in the food of the people. In Ireland, where the food of the people is inferior to that of the population in England, the children, both out of and within the union houses, and in various classes of society, are more subject to scrofula. The evidence derived from institutions for children in other countries in Europe, Asia and America, is further corroborative of the influence of a bad or defective diet in the production of the disease.

Mr. Phillips concludes with an opinion that the evidence adduced must produce the belief, that "whether children are brought up in town or country, whether their accommodations as to space be ample or confined, whether born of healthy or unhealthy parents, the influence of food in the production of scrofula is most important, and that the extent to which it prevails has a very evident relation to the diet of the child."

It is with me a subject of regret, that the evidence brought forward by Mr. Phillips does not make the same impression on my mind as on his own, because, after the immense labour which he has bestowed upon it, and his well known competency for the investigation, I can but distrust my own judgment; but it appears to me, that the facts brought forward prove, and amply illustrate, the influence of sufficiency or insufficiency of diet—which no one can doubt—but when examined critically, they fail to prove

that any modification whatever of the diet alone, either in an individual or a community, ever produced a case of tuberculosis. All the instances derived from the great factory towns belong to *combined* agencies; and whatever evidence might be adduced of deficient diet, in the classes furnishing cases of tuberculosis, it may be affirmed, I think correctly, that the respiration of a vitiated atmosphere, in the sense employed by Baudelocque, or in the more precise sense employed in this work, is always in operation. The quotations made by Mr. Phillips from Dr. Baron Howard's pamphlet and Mr. Carmichael's lectures, appear to me singularly unfavorable to the exclusive view of the sufficiency of bad diet for the production of the disease. Dr. Howard, after referring to the delicate state of health and enfeebled constitutions of the people most subject to this disease, describes their improvidence, which reduces them to the greatest poverty, "often bordering on actual starvation; their houses are almost destitute of furniture, comfortless and uncleanly; too often damp, cold and *ill-ventilated.* Their families are ill fed, badly clothed, and badly lodged." "They are extremely intemperate in their habits." "The effect of the intoxicating liquids they consume is of course to produce a temporary excitement of the whole system, which is succeeded by a corresponding depression." "These circumstances, together with *the want of an abundant supply of good air* and a proper amount of *exercise,* are sufficient to shew that even in times of the greatest prosperity, a large portion of the manufacturing classes is far from being in a state of vigorous health, and that many of them are on the verge of actual disease." Here are—combined—vitiated air, deficient nourishment, humidity, cold, intemperance, want of exercise, and the depressing passions, and it appears to me that neither any particular fact nor the whole body of evidence adduced by Mr. Phillips fixes, exclusively or mainly, on the diet as the cause of tuberculosis.

Comparing the workhouse child with the child reared in the cottage of the peasant, after shewing that glandular swellings, scrofulous caries and ulcerations are less frequent in the former than in the latter, Mr. Phillips proceeds to argue, that the one reared in the workhouse enjoys *no advantages* of which the one reared in the cottage is deprived, except an improved diet. Is that so? Is not the change of diet accompanied by more warmth, better ventilation, a dry atmosphere, something more nearly approaching to cleanliness; and is not the workhouse child withdrawn from the

influence of spirituous liquors? It is very difficult to estimate the effects of these different influences over the process of blood-making, but certainly the improvement of the diet in this case, as in most others cited by Mr. Phillips, cannot be wholly separated from the other influences. Louis examined the kind of diet of 30 phthisical patients, with the view to form an opinion of the influence it might have had in the etiology of the disease; 12 had been badly nourished from infancy, and 18 had always been well fed; no appreciable difference could be ascertained with respect to the period of the development of the disease; and this acute observer seems to have abandoned the idea, that any particular diet or any defect in the quality of the food, has any direct influence over the production of this form of tuberculosis.

The injurious effects of insufficient nutriment in tuberculous subjects, and its tendency to promote the development of the disease in those who are free from it, must be admitted. In explanation of these effects, we have to bear in mind that the food furnishes the pabulum of the blood, and if this be defective or vitiated, and the defect or vitiation is not corrected in the subsequent processes of blood-making in the lungs or other organs, the blood will be deteriorated in quality or defective in quantity. Mr. Phillips's statistics amply prove this, and they further prove that blood thus deteriorated acts at least as a predisposing cause of the disease, but they totally fail to prove that it necessarily becomes tuberculous, or that any modification of diet alone has in any instance produced the disease; science supplies many facts in evidence of the converse.

That no modification of diet alone is capable of producing a tuberculous state of the blood may be inferred from the following facts. Animals living upon more simple diet than man are subject to the disease; and it affects herbivoræ as well as carnivoræ (p. 352). In experiments performed upon animals by Majendie and others, a non-nitrogenous diet or a diet limited to one alimentary principle, produced an impoverishment of the blood, with emaciation and debility, ulceration of the cornea, stomach, intestines, &c., of a characteristic nature, but totally distinct from tuberculosis, and without the slightest indication of a single tubercle. The peculiar train of symptoms which attends *acute* and *chronic* starvation have only a very few points indeed in common with tuberculosis. Neither the use, the abuse, nor the exclusion of any particular food

has hitherto been found uniformly to correspond with the development of the disease or of any form of it; during famine and long sieges, when large bodies of men are exposed to an insufficient and unwholesome diet for a long period, the production of tuberculosis does not appear to be the result; scurvy, dysentery, low fevers and dropsy, but neither scrofula nor consumption are the consequences.

(*b*) *Absence or deficiency of one or more of the staminal principles of Food.*—It is stated above, that we have no data to determine whether any particular principle of the food is concerned in the production of tuberculosis. Empirical practice has lately furnished us with a fact, which may ultimately prove of immense importance in explaining the cause and essential nature of the disease, in connection with the present generally admitted principles of dietetics. Cod-liver oil has been proved, unquestionably, to produce a very decided change and a beneficial effect in the tuberculous constitution; the general symptoms of tuberculosis, especially the attenuation and debility, give way under its use, and local disease is often cured. It has not been shewn that the virtue of the oil is attributable to iodine or any admixture with the oily principle. We are therefore naturally led to the enquiry, whether a deficiency of the oily principle of the food, so essential to animal nutrition, has anything to do with the original production of tuberculosis. I have put the question to a considerable number of phthisical patients, and I have very generally found that they have, for a long period, had a distaste for fat and fatty articles of diet, and I have made some observations on the diet of infants and have frequently found a deficiency of a due proportion of the fatty element in their food. The fact is also very remarkable that butchers, who live on a great proportion of fat meat, are less prone to phthisis. But a question like this demands a rigorous investigation; in so far as a defective diet is concerned in producing tuberculosis, it remains to be determined what elements of nutrition or staminal principles are at fault.

A deficiency in some element or staminal principle of diet may be a true but not an all sufficient cause; it may require the co-operation of some other condition to give it effect; this will be more particularly adverted to in the last section of the present chapter.

(*a*) *Deprivation or defective quality of the breast milk.*—Donné

states, that milk globules are immediately converted into blood corpuscles when received into the blood by injection, and that young animals, when brought up on other substances than milk, are less perfectly nourished; he also ascertained, by direct experiments, that an inappropriate nourishment of young animals has a great effect in altering the shape and nature of the blood corpuscles.* The milk with which an infant is nourished being generally poor or defective in its staminal principles, will no doubt produce in the nursling all the effects of deficiency of food, and that debility which operates as a predisposing cause of tuberculosis and other diseases; or this influence may co-operate with others in the production of the disease, and children nursed by leucophlegmatic, chlorotic and anæmic women, may acquire similar states of constitution, which acting as predisposing causes, may contribute to produce the predisposition or the actual disease (p. 395); but although the defective milk alone may produce emaciation and debility to the most extensive degree, these are not necessarily followed by tuberculosis.

The deprivation of the breast milk no doubt frequently lays the foundation for the tuberculous modification of the blood. No other food can adequately supply its place. Even the milk of a foster mother is not so congenial to the constitution of a child as that of its own mother, and the milk of no animal can be advantageously substituted for it. Cow's milk, the most frequently resorted to, differs very materially from woman's; it contains more than twice as much of the proteine principle, and less of the oleaginous and saccharine principles; and, as remarked by Mr. Phillips, dilution cannot make it resemble that of woman. As suggested by Mr. Phillips also, the cow's milk employed to feed infants is generally a mixture of the milk of many cows, and it is well known that the digestion of an infant is liable to be deranged if suckled by two persons. Milk which has once been exposed to the air differs materially from that which flows from the breast to the digestive organs of the infant; its temperature is changed, it has given off a fine halitus, it has commenced separating into two parts, it has lost its homogeneous state, and it never can be reconstructed. Independently of this, a cow may be diseased, and its milk may be deteriorated in consequence. There can be no surprise that children brought up by

* Microscopical Journal, 1842, p. 245.

hand should so frequently fall into that state of debility which acts as a predisposing cause of tuberculosis, and that, with the co-operation of more direct causes, they should actually become tuberculous.

2.—POISONS AND MEDICINES.

(*a*) *Poisons or deleterious substances contained in the food.*—As there is no proof that any definite poisonous or injurious substance vitiating the atmosphere is a cause of a tuberculous state of the blood, so is there none that such a substance introduced by the food can have the effect; the opinions which have been entertained to the contrary are purely conjectural. The same question has arisen with respect to the purity of water, and a similar remark is applicable.

(*b*) *The abuse of certain medicines.*—The occurrence of scrofula in the Bengalese, in Calcutta, is attributed by Mr. Martin (Phillips on Scrofula, p. 339) to the abuse of Mercury and Arsenic, administered by the native empirics. "Arsenic is given liberally in every form of fever, carefully avoiding evacuants, and as carefully excluding ventilation." Mercury is quite as freely exhibited, and with fully as evil an effect on the public health, amongst the indigent natives. The two are often alternated, and the use of these medicines is never considered a prohibition from bathing in rivers and tanks, even during the cold season. To these substances Mr. Martin attributes the frequency of glandular and other scrofulous affections.

Sir J. Clark also believes that Mercury is capable of "inducing," tuberculous disease (lib. cit. p. 238) but he does not employ the term in the strict sense that it is used in this work. I understand him to mean that it debilitates the system, and in that way predisposes to tuberculosis.

3.—DRINKS.

(*a*) *Impure water.*—Facts are not wanting, at first sight, favorable to the conclusion that impurity of water is the efficient cause of tuberculosis. There are very few communities in which water, even comparatively pure, can be commanded, so that such a cause coincides with the universality of tuberculous diseases. Impurity of water in particular localities has been regarded as the cause of bronchocele, this being considered a tuberculous affection. There are also reputed facts available, tending more directly to implicate

impure water as a cause of scrofulous and tuberculous diseases. Dr. Lambe quotes from Dr. Percival, that the people who use the waters of the river Kireuga in Siberia become scrofulous.* The same physician also quotes M. Laignieres, a physician of Rheims, (in which town the Hospital St. Marcouff was appropriated solely to the victims of tuberculous disorders), to the effect that according to the hospital register, the cases of scrofula and bronchocele were reduced one half by the town being supplied with better water. Heberden gives a single case of strumous swellings which appeared to be produced by impure water; the individual had been free from strumous taint for 30 years, and the symptoms appeared after drinking impure water for a few years; the lymphatic glands in the neck and axilla swelled and suppurated as long as he used the impure water, but after he began to use a purer sort, the swellings began to recede, and had not returned after a lapse of thirty years.† An additional argument is employed by Dr. Lambe from the beneficial effects of the pure water of Malvern in many scrofulous cases.

I reproduce these statements because impurity of water has been overlooked by some recent writers as a possible cause, and not because, although admitted as established facts, they justify any conclusion. With M. Lebert's positive affirmation before us, that the cause of tuberculosis is absolutely unknown, any cause by which a special deterioration of the blood may be produced, ought not to be overlooked. Dr. Lambe believed that impure water conveys into the blood a septic poison, thus anticipating some opinions on the pathology of the disease, recently promulgated—that it is a poison of the blood.

(*b*) *Excess of calcareous salts.*—Connected with the subject of diet and water, and more especially the latter, the following observations, if to be depended upon, are important. Tuberculosis in its various forms—scrofula, tabes mesenterica and phthisis—has been attributed to the calcareous salts of the blood; this notion appears to have originated in M. Warner, who observed that a particular district in France (Sologne d' Orleannais) is exempt from all these diseases. The district is peculiar as respects its soil, having no calcareous earths in its composition—the vegetation being principally that which has silica and not lime for its basis.‡

* On Constitutional Diseases, 1805, p. 100. † Commentaria, p. 362.
‡ Mem. de 'L'Academ., Lancet, vol. i, 1848, p. 642.

The frequent occurrence of tuberculosis in cows, the large quantity of cretaceous matter found in their diseased lungs, and the large proportion in which the salts of lime enter into the composition of tubercles in the human subject, are facts which may properly be placed in juxtaposition with this statement.

(*c*) *Spirituous drinks.*—The abuse, if not the use of spirituous liquors, deteriorates the physical energies and powers of the individual, and, by diminishing the vitality of the blood, acts as a predisposing cause of tuberculosis. The offspring of intemperate parents and children nourished by intemperate nurses are also by their debility and weak organization predisposed to this disease, and there is reason to believe that this predisposition is aggravated from generation to generation by continued habits of alcoholic potation. The writers on total abstinence maintain that the use of these fluids is capable of producing consumption and other tuberculous affections. Others assert that it is the most frequent exciting cause of the local aggregation of tubercles in the tuberculous constitution.* The excessive use of ardent spirits produces extreme emaciation; and even where there is, for a time, partially or generally an unusual accumulation of fat, emaciation sooner or later sets in, unless some accidental or acute disease destroys the individual. The emaciation affects the cellular and muscular tissues as in tuberculosis. Notwithstanding this, a careful consideration of all the facts brought forward by the best informed pathologists, and all the direful effects of intemperance, leads to the conclusion that tuberculosis and the formation of tubercle is not one of the effects of alcohol, either in the human frame or in the lower animals. Amongst other distinctive differences, the morbid effects which result from the use of alcoholic fluids are exhibited especially in the nervous system, whereas in tuberculosis this system is, in the greater number of instances, for a lengthened period, and very frequently altogether, exempted.

Dr. Guy, of King's College Hospital, has shewn, from the statistics of the hospital, that phthisis exhibits an increased ratio of frequency in certain persons exposed to intemperate habits; there having been two cases of pulmonary consumption to five of all other diseases, in such persons, a ratio much higher than the average. Not only was the proportion of cases large, but the disease occurred early in life. This was illustrated in the case of pot-boys,

* Bacchus, by R. B. Grimrod, Ed. 2, 214.

who are peculiarly exposed to the temptation of drinking; 8 out of 25, or 1 in 2·50, of whose diseases were consumption, and a proportion of these cases occurred under 40 years of age, and especially between 30 and 40. A greater proportion of licenced victuallers also than of tradesmen generally, of pot-boys than of footmen, and of brewers' draymen than of labourers, die of consumption, and at an earlier age.

The statistics from which these results are derived, are unfortunately too limited to justify a conclusion; but admitting that they express general facts, there is no proof that the effect is the result of the assigned cause. There is no class in the community so completely immersed in an atmosphere not sufficiently renewed, and in the wider sense vitiated, than licensed victuallers and pot-boys; their rooms and habitations are notoriously confined and ill-ventilated; they are up early and in bed late, and spend the greater part of their time, Sundays and working days, in the tap-room. The little exercise the pot-boys have, during certain hours in the day, is totally inadequate to renew the air in the chest, and counteract the stagnation of the greater part of the day; and the masters themselves frequently take little or no exercise out of doors. There is accordingly as much reason to attribute the effect to the respiratory air being insufficiently renewed, as to the alcohol.

The British troops in the East Indies are a body of men particularly addicted to the use of spirituous liquors, and yet the occurrence of tuberculosis in the form of phthisis is extremely rare—not two cases occurring annually in 1000 soldiers, although at other stations, where they are less intemperate, from six to ten cases per 1000 occur annually.

Dr. Peters, an American physician, made an accurate examination of the necroscopic appearances in the bodies of nearly 70 persons who died from the excessive use of ardent spirits. In no one instance did he meet with a tubercular abscess, even of the smallest size, while a small number of chalky tubercles was frequently noticed. Cicatrices were also frequently met with marked by the presence of a puckering of the surface of the lungs, and the existence of solid bodies readily felt before the lung was cut into, which proved to be lumps or striæ of callous fibrous tissue, around which were rarely discovered a few discrete, grey, crude, small tubercular granulations; these appearances, in many instances

being strictly confined to the upper third of the superior lobes, and the rest of the lungs entirely free from either old or recent tubercular disease.

Dr. Peters remarks that, according to Rokitanski, Andral, and Engel, the blood in the tubercular cachexia is arterial and rich in fibrine; hence alcohol would seem to produce a state of blood opposite to that which obtains in this disease, and may thus prevent the development of it. But so far from this being the case, in tuberculosis, the blood is somewhat deficient in fibrine—it is not until local disease sets in that a state of "hyperinosis" occurs—nevertheless, the excitement produced in the blood by the constant presence of hydrocarbon, in the form of alcohol, is most likely antagonistic of the low vitality which characterizes tuberculous blood. Dr. Peters's necroscopic observations accord with general experience; the excessive use of alcohol does not destroy life by producing tuberculosis, but rather by producing other diseases, as those of the nervous system and of the liver. The wretched parents who poison their children by spirituous potations, produce the most extreme degree of marasmus, but it has by no means been proved that they produce tuberculosis. Alcohol, however, may excite local disease, or aggravate it when it exists, in tuberculous subjects, and in actual practice we may generally meet with cases, wherein the tuberculous state of the blood is complicated with the poison of the blood by alcohol. The great practical question is—whether the moderate excitation produced by the continual presence of a small proportion of alcohol in the blood is prophylactic or curative of the tuberculous habit, or whether it is calculated to produce the disease. Facts are not wanting which tend to establish that the tuberculous constitution, where there is no local disease, is benefitted by the moderate use of these fluids, and this is sanctioned by theory, but then the stimulus must be moderate, uniform, constant, and accompanied by a generous diet containing a proper proportion of the staminal principles, and essential elements of food, and accompanied with sufficient exercise in a good air—otherwise—if exhaustion and unanswered stimulus is produced, the waste of material in the blood, and its diminished vitality, is favorable to the tuberculous transformation, and may act, on the one hand, as a predisposing cause, or on the other, the use of alcohol may totally prevent tuberculosis—it may even cure it after local disease has supervened—by poisoning the blood and at the same

time destroying the organization of the various structures, and producing death by other diseases.

(*c*) *The habitual use of diluting fluids.*—Among the causes to which the disease has been attributed, are the premature or the excessive use of tea, coffee, chocolate, cider, and acid wines, and diluting fluids generally; but there is not the slightest foundation for attributing the tuberculous transformation of the blood to the specific effects of any of these substances.

As respects *dilution,* in a state of the constitution where the blood is aqueous, and of low vitality, the cell-growth and nutrition weak, the structures generally soft or flabby, the digestion imperfect, and the vital powers dimished, there can be no question that, carried to an unnecessary extent, it is injurious. The normal constitution of the blood demands a certain proportion of water to compensate for the continual waste, but the quantity of fluid drunk is too often regulated more by the force of habit than by the demands of nature. Excessive dilution is so far concerned in the etiology of tuberculosis that it injures the powers of digestion, and promotes that debility which has been described as an important predisposing cause of the disease.

III.—HÆMATIC AGENCIES.

(*a*) *Excessive Loss of Blood.*—There is probably no cause to which tuberculosis has been imputed which has appeared more direct and more tangible than excessive hæmorrhage. Hæmorrhages from the uterine system and excessive bleeding in the treatment of disease have appeared to be frequently followed by phthisis. The tendency of hæmorrhage is, as a primary effect, to dilute the blood; the absorption of aqueous fluid takes place rapidly, as a means provided by nature to sustain the necessary bulk of circulating fluid, but a much longer time is required to replace the organizable constituents of the blood; the period depending greatly upon the constitution of the individual. And while this is being effected direct debility is the result, exhibited, especially, by direct loss of vital power and by symptoms of nervous exhaustion. In some constitutions, if hæmorrhage proceeds to a certain extent, whether by large and rapid discharges or by repeated drainings, the debility attains a point from which the individual never recovers. This debility, which is direct and strictly analogous to the debility of tuberculosis, (p. 81) depending, as it does, upon a condition of the

blood having many of the characteristics of tuberculous blood (p. 15), is of all other things best calculated to precipitate a tuberculous constitution into active disease; it also operates as a powerful predisposing cause (p. 395) of the tuberculous transformation of the blood, where the individual is at the same time subject to the operation of more certain causes of the disease.

Loss of blood from the lungs, whatever may be its anatomical cause, has an equal etiological import with that from any other source; but hæmoptysis has its special relation to the disease as one of its most frequent symptoms. (p. 76, 268.)

(*b*) *Excessive Secretion or Excretion.*—Excessive discharges from the mucous membrane of the alimentary canal, the skin and other outlets, occur frequently in tuberculous and non-tuberculous subjects. These discharges, especially when of a profuse nature, operate on the system in the same way as loss of blood; by promoting the absorption of aqueous fluids they tend to dilute the blood; and frequently reduce the individual to a state of debility which acts as a predisposing cause of the disease.

(*c*) *Suppression of the Secretions.*—It has been asserted, that scrofula and phthisis may be produced *ad libitum* by gradually suppressing the cutaneous functions. No doubt this is one of the most direct means by which the healthy constitution of the blood may be changed. When the function of the skin is arrested in animals, by varnishing, the health becomes rapidly deranged, they die of marasmus, and miliary tubercles are said to be found in their lungs, which by their paleness and softness appear to be recently formed. When the cutaneous function is only partially arrested by this process, the blood remains coagulable and presents a pale and little consistent buffy coat. Many of those causes which have been regarded as inducing causes of the disease might act in this way. Thus, humidity acts as a direct check to the cutaneous transpiration. Certain degrees of cold will have the same effect, particularly if the skin be dirty and unhealthy. Deficiency of muscular exercise may act in the same manner. Many observers have remarked that the cradle of phthisis and scrofula is the deepest vallies, where the air is calm and at its maximum of humidity. Muscular exercise, exciting a mild transpiration, triumphs over all these causes, which act by preventing transpiration; to this circumstance it has been remarked the rarity of phthisis in coal pits is attributable, where man is exposed at once to humidity and

mechanical particles, which deposit themselves over the skin, and which, if not continually separated by the transpiration, would ultimately furnish a varnish capable of annihilating its functions. The same remark may be made of paper-makers, threshers of corn and other dusty occupations. In the vast cotton establishments of Gond, the young women exhibit a remarkable aspect of health and freshness, although continually exposed in the workshops to clouds of powder; this is owing to their activity, which it is said preserves them from tuberculosis, so common among weavers and lace workers whose employment is sedentary.

An arrest of the cutaneous function or of the functions of other secreting and excreting organs most probably co-operates, in many instances, with other circumstances relating to hæmatosis, in the production of a tuberculous state of the blood, but the facts are not at present sufficient to warrant the opinion that any case of tuberculosis was ever produced by this cause alone.

Uncleanliness alone has even been referred to as a sufficient cause of scrofula; but the English and the Dutch, who are proverbially cleanly people, are also proverbially scrofulous, and sometimes children brought up in filth and dirt escape; the German Jews, who have the reputation of being the dirtiest in the world, are subject to the disease, so also are the children of our aristocracy who are taken the greatest care of, are continually washed and bathed, and scarcely ever wear soiled linen.

In so far as a want of cleanliness has any effect in aiding the development of tuberculosis, it is by the obstruction of the cutaneous transpiration, and in all that relates to the etiology and the treatment of tuberculous affections we must not forget the various and compensating offices which the different secretions perform. Whatever the real cause of the disease may be, a free and healthy action of the skin may in many cases prevent its taking effect.

IV.—FUNCTIONAL AGENCIES.

1. EXERCISE.

(*a*) *Excessive Bodily Fatigue* has been assigned as a cause of tuberculosis, but there are no facts to shew that it operates as a special cause; among animals, the horse, it is true, is extremely liable to the disease, and he is at the same time subjected to the greatest muscular exertion. He differs in both respects from the domestic dog; but the horse is also often badly fed, confined to ill-

ventilated stables, and drinks bad water, a combination of causes which the dog is rarely subjected to. According to Dr. Guy's statistics, men subjected to severe bodily labour die of phthisis at an earlier average age than those whose occupations require only moderate exertion, and this earlier mortality appears to depend on an excessive mortality under 20 years of age; from which it is inferred, that employments requiring great exertion are unfavourable to youth as respects the development of consumption. No doubt, like other influences capable of exhausting vital power, excessive bodily fatigue may have the effect of predisposing the economy to the action of the more direct causes; under exhaustion digestion is impaired, the respiratory changes of the blood are reduced, and the blood itself is debilitated, but beyond this the morbid effects of excessive bodily labour cannot be shewn to have any relation to the disease, although, when associated with other causes, its influence is by no means trivial.

(*b*) *Deficiency of Exercise.*—Observation sanctions the opinion that sedentary habits of life have a most important influence in the production of tuberculosis. If one author has attributed the morbid hæmatosis, with great shew of reason, almost exclusively to defective aeration, and another to deficient food, I believe that I should have almost equal grounds for referring it to a deficiency of moderate and healthful exercise. A close examination of infants who ultimately become scrofulous, will almost always detect a neglect of those nursing exercises by which the circulating and respiratory motions are promoted and healthful hæmatosis secured. The same remark may be correctly made of young children. Hofer, who first described cretinism, referred it to indolence and gross diet (F., p. 48). Habits of listlessness, not to say indolence, are also frequently the precursors of tuberculosis in young people about the age of puberty, and many of the occupations of life which necessarily engender sedentary habits are particularly productive of phthisis. Dr. Guy found, in the close workshops of a printing establishment, the compositors, whose employment is sedentary, fell victims to phthisis in the proportion of 44 per cent. to 31½ per cent. of the pressmen, who although breathing the same air and in every other respect subject to the same habits of life, differ only in the active bodily exercise of the press; and among the same class of operatives the deaths from the same cause did not exceed 25 per cent. in those who use exercise in the open air. We shall have occasion to point out how

extensive the influence of this cause must be in promoting the action of other causes of defective hæmatosis.

It is forcibly pointed out by Mr. Carmichael,* that want of due exercise leads to an inert secretion of the gastric juice and bile. The secretion of the bile, in particular, is more dependent upon the general exercise of the body than any other secretion. The situation of the liver, immediately under the diaphragm, subjects it to constant motion, and pressure from the action of that muscle; and, admitting that the bile is secreted from the portal ramifications, we know how much the venous circulation generally is dependent upon muscular action. The whole physiology of the liver and portal system establishes the importance of exercise to the due secretion of the digestive fluids, and there can be no doubt, that the species of dyspepsia which is so constant an attendant on tuberculosis (p. 85), the increased volume of the liver (p. 295) the vascular congestion of the intestinal tissues (p. 170), and the vitiated secretions (p. 82) are frequently produced in tuberculous subjects of all ages, by too sedentary habits. As remarked by Mr. Carmichael, the motion of the diaphragm in easy respiration, while the body is at rest, appears only sufficient to prevent, as it were, a complete stagnation of blood in the liver, and is frequently inadequate to obviate diseases which arise from a languid circulation through that organ. In tuberculosis, characterised as it is by languor of the circulation (p. 88), this cause must be more especially operative.

No writer has given more unequivocal proof of the tendency of deficient exercise to produce scrofula than Mr. Carmichael (lib. cit., p. 35). In a parochial school, where there were twenty-four girls, in every respect well fed, clothed and lodged, seven out of the number, in the summer of 1809, became affected with scrofula, although not one had the disease when admitted. On the most minute enquiry, there was not any reason to attribute the prevalence of the disease among them to any defect of diet; but, during the preceding winter and spring, a very small yard, their only play-ground, was flooded in consequence of heavy rains, and the mistress of the school had received directions to keep the children perpetually within doors, at their school-books, which totally deprived them of the little exercise to which they had been accustomed. In a short time from the commencement of this sedentary life, scrofula began to make its

* Essay on Scrofula, 1810, p. 27.

appearance, and afterwards affected near a third of their number; yet before this privation of exercise not one was affected with the disease, although at that period they were treated so indifferently in respect of diet, that the woman who then superintended them was afterwards dismissed from her situation, on account of the bad quality of the provisions she provided for their use. Her total inattention allowed them the liberty of playing and exercising as they chose; and to this circumstance, Mr. Carmichael remarks, they owed their health, for they made such good use of their liberty, that not one of them shewed the slightest symptom of scrofula, until they were some months accustomed to confinement. In another school there were thirty girls, fed in the best possible manner, but out of this number there were, in the summer of 1809, six badly affected with scrofula, although when admitted there was not one; the true source of the disease was found in neither yard nor play-ground existing, and the children being obliged to remain in the school or their bedrooms during play hours.

These examples are, to my mind, most instructive; they shew that of two anti-hygienic influences—want of exercise and bad diet—the former is incomparably the most efficient in the production of the disease; if, when both are simultaneously in operation, it be not the true cause.

The deficiency of muscular exertion, in these cases, must not, however, be regarded apart from the insufficient renewal of the external air, which, under such circumstances must almost necessarily have happened. It has already been shewn that the latter agency operates through the comparative stagnation and insufficient renewal of the air habitually contained within the chest. No circumstance has this effect more directly and more decidedly than insufficient bodily exertion. Here then, the two agencies which appear to possess the most influence over the production of tuberculosis have the same *modus operandi*, and their co-operation is attended with the most decided effects. It is by no means easy to estimate the relative degree in which each of these agencies operates without more extended data, but we may state generally, that a life of moderate healthful exertion in an atmosphere to a certain extent insufficiently renewed is less likely to result in tuberculosis than a perfectly sedentary life in the purest air in the world.

Sedentary employments.—In Dr. Guy's "Contributions to a knowledge of the Influence of Employment on Health," (Journal of the

Statistical Society) drawn from the records of King's College Hospital, it appears, as a statistical result, that in single females leading a sedentary life, as book and envelope folders, bonnet cleaners, embroiderers, sempstresses, &c., the cases of pulmonary consumption, compared with all other diseases, were three times as numerous as among those engaged in non-sedentary domestic occupation, as servants, housekeepers, shopwomen, &c.; and men following in-door occupations fall into consumption much earlier in life than those following out-door employments. In females generally, the ratio of cases was highest in those following indoor sedentary employment; less in those having mixed in-door occupation: and least of all, in those employed out of doors. In men, the ratio of cases of consumption to all other diseases, is somewhat higher in those following in-door occupation than in those working in the open air; and in men following in-door occupation the ratio is highest where there is least exertion; and lowest in employments requiring strong exercise; and the disease occurs earlier in life in those whose occupations give a high ratio of cases.

2. SEXUAL EXCESSES AND ABUSES.

A recent author—M. Fournet—and many who have preceded him, lay great stress upon venereal excesses as a cause of tuberculosis. Lugol states that it is a cause of debility in the parent, and of "hereditary" scrofula in the offspring. Many authors, both ancient and modern, impute to it the direct production of consumption. Viewed as a disease of the blood, these excesses no doubt act as predisposing causes, diminishing the vital powers of the blood and deranging and degrading its physical composition. No doubt also that, like many other debilitating causes, these excesses, in tuberculous subjects, precipitate the disease, and promote the deposit of tubercle. But no facts have been well observed, which prove that they ought to be regarded as inducing causes; the cases of extreme marasmus which have resulted, have not been shewn to be attended with tubercular deposit; and their pathology in many respects differs essentially from that of tuberculosis.

(*a*) *Masturbation.*—MM. Rilliett and Barthez attach some importance to this as a cause. They ascertained that a considerable number of their patients had contracted this vicious habit, and in many it was carried to a very great extent (*une véritable passion*).

Moreover, they ascertained, as they state, satisfactorily, that the vice was more general amongst the tuberculous than the non-tuberculous, and in three cases they were unable to refer the disease to any other cause whatever. The proofs are insufficient to establish this as an efficient cause of tuberculosis, but there can be no doubt whatever that it produces that prostration of the nervous powers, debility, and poverty of blood, which acts so powerfully as a predisposing cause, by which other antihygienic causes are rendered so efficient; and it is much to be feared that in this way, as well as by promoting the activity of an otherwise latent hereditary tuberculous taint, in either sex, it is but too frequently attended with the most pernicious consequences.

3. MENTAL EXCESSES AND ABUSES.

(*a*) *Mental excitement.*—Many of the remarks made in former sections apply here; there is great difficulty in separating the effects of mental exertion from those of sedentary habits, the breathing of a confined atmosphere, want of exercise, a particular kind of diet, and other etiological influences. No doubt the blood of the hard working student and recluse frequently becomes tuberculous; he is frequently also the subject of melancholy and of the depressing passions, and as such he is liable to all the effects of these passions, presently to be described; but there is more reason to regard mental excitement, taken alone, as a prophylactic against tuberculosis than as a cause of the disease, and in the chapter on treatment it will be seen that one of our indications of cure, of almost universal application, is derived from the beneficial effects of appropriate and judicious mental stimuli.

(*b*) *The depressing passions.*—Many authors of the highest consideration, Morton, Avenbrugger, Laennec,* Blakiston and others, consider the depressing passions as a cause of tuberculous diseases. Laennec designates it as an "occasional cause," but he means a real, efficient cause, not only of this, but of other diseases, resulting in heterologous nutrition, a cause of "assured operation if strong and of long continuance," and "perhaps the only cause of the greater frequency of consumption in great cities."

The writers who have assigned this cause have said little of the effect of the chronic emotions or passions on the corporeal frame, beyond enumerating them among the causes of one of the varieties

* Transl. by Dr. Forbes. Ed.: 3, p. 333.

of tuberculosis; but in order to estimate the influence of such a cause, it is essential to bear in mind the corporeal effects of such affections of the mind,—dejection, constant anxiety and sadness, distress, sorrow, grief, remorse, melancholy, despair—the various forms assumed by the emotions of the mind, produced by painful sensorial impressions, which come under the general description of the depressing passions.

The general corporeal effects of the different modifications of the depressing passions consist in—a check to the usual activity of the molecular motions in the blood, with languor and torpor of the circulatory, respiratory and absorbing functions, and an universal depression of vital energy. It is also probable that under the influence of the depressing passions the *electric tension* of the whole system is diminished, and that this may act as a cause of direct debility.

These effects are shewn by smallness and slowness of the pulse, a sense of general languor and deficiency of muscular force and action, contraction and shrinking of the skin and general surface, with coldness of the extremities and paleness of the countenance; and as the molecular changes going on in the blood in the capillary system are thus manifestly diminished, the heart and large vessels, and especially the system of the pulmonary arteries, become loaded and distended, producing a sense of oppression and precordial anxiety, with slow and small or laborious respiration. The circulation in the liver being rendered slower, and an unusual quantity of blood being thrown upon it, the function of this viscus is liable to be disturbed. The arrest of the molecular actions in the blood, by the diminished action in the skin and lungs, the diminished circulation and the depressed vital energy produced by these passions, with the want of exercise which usually follows, and the functional derangement of the liver, are attended also by loss of appetite and a derangement of the whole process of digestion.

When the operation of the depressing passions is slow and long continued, among the most prominent effects we find the bloom of health disappearing, the face grows pale and emaciated, the adipose support of the eyeball gradually diminishes, and the eye becomes sunken, the fat generally is absorbed, and the muscles become weak and relaxed. They appear to depress the vitality of the blood, and to undermine the source of all the vital energies,

without any previous increase of action, and to produce a gradual decay of the bodily functions, which may be sustained for many years, ultimately proving fatal, and the patient dying exhausted.

Such being the corporeal effects of the depressing passions, there can be no doubt that the blood produced under their influence, as compared with healthy blood, must be in a state much more ready to take on the tuberculous transformation, and that these passions thus act as predisposing causes of tuberculosis; but the question in this place is, whether the depressing passions alone are capable of producing tuberculosis.

In illustration of the effects of the depressing passions in producing consumption, Laennec relates a very remarkable history, of which the following is an abstract. He had under his own eye, for ten years, a religious association of women, the rules of which were extremely severe. The diet of these persons was very austere, yet by no means beyond what nature could bear, but the ascetic spirit which regulated their minds was such as to give rise to the most serious and surprising consequences. Their attention was habitually fixed on the most terrible truths of religion, and they were constantly tried 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 consequence of this discipline was the same in all; after one or two months the catamenia were suppressed, and in the course of one or two months thereafter phthisis declared itself! Almost all those who by Laennec's advice left the establishment as soon as the consumptive symptoms began to appear were cured, although several of them had exhibited well marked indications of the disease. During ten years he witnessed the entire renovation of the association, two or three separate times, owing to the successive loss of all its members, except a small number, consisting chiefly of the superior, the gate-keeper, and the sisters who had charge of the garden, kitchen and infirmary. Laennec goes so far as to say that, in other situations it has appeared to him that almost all the cases of phthisis he met with, in individuals not constitutionally predisposed to the disease, might be attributed to grief, either very deep or of long continuance. Blakiston, also, lays great stress upon mental depression as a special cause of phthisis, illustrating his opinion by reference to many cases which seemed to arise out of attacks of syphilis or gonorrhœa in young men who had previously

enjoyed excellent health, and were apparently free from any kind of constitutional taint whatever; he refers the effect to living in constant dread of discovery by their friends, and to the suffering from anxiety of mind; and in his experience other sources of mental depression have been often followed by phthisis.

There is great difficulty in separating this from other causes of morbid hæmatosis. In Laennec's cases we observe that a rigid diet, and we may infer that want of exercise, co-operated, as causes, with the depressing passions; it is not improbable also, that defective aeration was in play. If so, we had the coincidence of all those causes which have been proved to be most intimately concerned in the production of the disease. It is also very remarkable that those individuals who took more exercise than the others, and as respects whom, the discipline was in all probability, otherwise relaxed, were the only exceptions.

There are certainly none of the causes, to which tuberculosis has been attributed, so universal in their influence over all the processes in the animal economy which contribute to hæmatosis. By defective diet the pabulum for the formation of healthy blood is diminished, but if a deficient or even a defective chyle is submitted to perfect aeration in the lungs, and the individual is otherwise subject to hygienic influences, it is astonishing how perfect the health may be, and how long it will continue so upon a very small quantity of food. Again, individuals being well fed, taking suitable exercise, and placed under favorable circumstances for cheerfulness of mind and general comfort, may breathe habitually air worse than that of the densest cities, and remain in good health for years; and it frequently happens that one of these causes of diseased blood is in operation alone without any apparent effect on the health. But the depressing passions act universally; they have a direct influence on the blood, owing to the universal reciprocal relations of nerves and blood; by injuring the processes of digestion, they diminish the quantity and deprave the quality of the chyle; by lessening the respiration they produce all the defects in the blood, of a vitiated atmosphere; by diminishing the muscular strength they lead to aversion to exercise; they deteriorate secretion and absorption. It is no argument against the depressing passions being regarded as an adequate cause of tuberculosis, that animals and the youngest infants are subject to

the disease; the former have their instincts, and these may well be supposed to be attended with corporeal effects analogous to those of the passions in mankind; and mental and sensorial pleasurable excitation is as essential to the well being of the infant as to the adult. The depressing passions produce a depressed condition of corporeal life—structural and functional, and whether combined or not with other causes of that condition, regarding tuberculosis as a disease of the blood, there is no cause to which it has been imputed, which from its universal influence on that fluid, is so adequate to produce the effect.

The excessive mortality in cities and towns, frequently altering and even reversing the relative liability of the sexes to tuberculosis, but more particularly to phthisis (p. 396), and rendering the male sex more frequently its victims, has been referred, with very great probability, to mental and moral causes. It is in large towns and cities, as observed by Dr. Duncan,* that the men are so much exposed to the "play of passion" arising from over-excitement on the one hand, and the fulness of work on the other. "The mind is perpetually on the stretch in the acquirement of knowledge; ambition has the widest field for its exertion, and vice the most favoured opportunities for its indulgence; cupidity and vanity find equal scope for their development, the love of speculation is gratified, and innumerable incentives to mental and moral action and emotion are in play, and it is thus that the collapse and depression consequent upon over-exertion, mortification, hope deferred and disappointment, produce their direct effects." In the retirement of a country life, on the contrary, there is greater tranquillity, a healthier excitement without fatigue and collapse, the enjoyment of less intense and more pure and permanent pleasure, and the absence of some of the more acute, harassing, and exhausting modes of pain and misery.

Dr. Theophilus Thompson has given a very interesting illustration of this principle of mental and moral depression as a cause.† The occurrence of the pulmonary form in females appears to be increased in certain towns and countries, where the number of illegitimate children born is greatest, as shewn in the following table:—

* Dublin Journal, vol. xxxvi, p. 268.

† Lancet, 1851, vol. ii, p. 549.

TABLE XXI.

Proportion of Deaths from Phthisis to every 200,000 of the Population.			Proportion per cent. of Illegitimate Children to both.
	MEN.	WOMEN.	
London	·455	·377	3·2
Liverpool and West Derby . . .	·595	·571	3·6
Manchester and Salford . . .	·549	·548	5·8
Leeds	·440	·477	6·0
England and Wales	·378	·408	7·0
Paris, according to Benoiston . .	·208	·408	28·0

The per centage of illegitimate children to the whole number of births is drawn from a return of a different year to the other columns, and there are other defects in the table; but, as well remarked by Dr. Thompson, the more frequent occurrence of illegitimate births in a town or district indicates a lower system of morality, and an increase of moral disquietude and misery, and of the depressing emotions and passions.

V.—PATHOLOGICAL AGENCIES.

1. PREVIOUS DISEASES.

It has already been stated, that various diseases which impoverish the blood, produce a condition or state of the economy which acts as a predisposing cause, and that these same diseases may have the effect of aggravating the tuberculous state of the fluids and solids, where a predisposition exists, and thus lead to the full development of the disease. Pathologists, however, have entertained the opinion that certain diseases have a more direct effect in inducing tuberculosis in the individual. Those to which this effect have been attributed are inflammations, particularly of the bronchiæ, pleuræ and lungs; exanthematous fevers, particularly rubeola, vaccinia and scarlatina, especially where retrocession of the eruption occurs; fevers of long duration, particularly where relapses or incomplete crises occur; hooping cough; dyspepsia; syphilis; and probably some others.

Inflammatory affections of various organs, no doubt, frequently lead to the deposition of tubercle; and acute inflammations, as pneumonia and pleurisy, appear to terminate in tuberculosis and the deposit of tubercle, but here the question of causes is very complicated. Doubtless, in a great proportion of cases, a predisposition,

more or less decided, exists; but it must be admitted that in some cases no trace of it can be discovered.

(*a*) *Bronchitis*:—is regarded by a great number of authors as a cause of consumption. Hufeland, Tissot, Baumes, Broussais, and I believe all the disciples of his school, and many practitioners in this country, antecedent to the publication of Sir James Clark's work, held that opinion. The distinction so accurately defined by the latter, between the constitutional disease and its local development, led to more correct views on this part of the subject, and at present it may be stated, as an incontrovertible proposition, that so long as the blood remains healthy or has not undergone the tuberculous transformation, bronchitis cannot produce tuberculosis. The pathological anatomy shews clearly, that grey granulation and crude tubercles occur in the lungs while the bronchiæ remain perfectly healthy, and that acute phthisis may occur, with caverns and great pulmonary destruction, without even redness of the bronchial tubes presenting itself (p. 274). It is found also that individuals who suffer from pulmonary catarrh for years, producing emphysema and other pathological results, do not ordinarily become tuberculous. In 42 autopsies of individuals with pulmonary emphysema, after more or less intense bronchitis of many years duration, Louis found tubercles deposited less frequently than in individuals who die of chronic diseases generally; in 10 only there were a few grey granulations at the summit of the lungs. So, also, in individuals who die with dilated bronchiæ, the mucous membrane being thrice its natural thickness, intensely red, granulated or mammillated, the duration of the disease having been from two to six years, in three cases out of eight only, a complication with tubercle, slightly advanced, was observed. Added to this, pulmonary catarrh commences at the base and tubercular deposit at the summit of the lungs (p. 257); and of 174 phthisical cases interrogated by MM. Louis and Briquet, 56 only admitted that they had been subject to catarrh, while 83 declared that they had been very rarely affected with it. These facts, taken with those contained in the chapter on the pathological anatomy, are conclusive, not only that bronchitis has no direct relation to the disease of the blood, as cause and effect, but that it has also very little effect as an exciting cause of the deposit of tubercles in the lungs. Laennec, Louis, Clark, Fournet, at the present day Andral, and most pathologists, regard bronchitis occurring in tuberculous subjects as a disease for

the most part consecutive to the deposit of tubercle.* Sir J. Clark, however, very fully describes the effects of long continued bronchitis as an exciting cause of the deposit of tubercle and the development of tuberculosis pulmonalis (l. c., p. 240).

(*b*) *Pneumonia.*—The frequent occurrence of pneumonia as one of the post mortem appearances in individuals who die of tuberculosis, and the very great frequency of tubercles in the *lungs* leading to the fatal termination of the disease, has sometimes led pathologists, not properly distinguishing between the constitutional and the local disease, into the fatal error of referring "consumption" to inflammation of the lungs. The relation of pneumonia is the same as that of bronchitis to tuberculosis; it is a secondary affection as respects the constitutional disease, and only occasionally a primary affection (p. 262, 290) as respects the local deposit of tubercle.

Laennec, Carswell, Clark, Andral and Louis concur in the opinion, that in almost all cases, pneumonia is an effect and not a cause even of the deposit of of tubercle. Andral's conviction on this point is of the more importance since at one time he entertained an opposite opinion. "The more I have observed," he states, "and studied all the circumstances of the formation and development of tubercles, the more I come to adopt the opinions of Laennec on the part which inflammation plays as to their origin. . . . At present I am convinced that there is no necessary connection between the production of tubercular matter and the existence of an antecedent irritation, producing congestion as a consequence and then tubercle. It is certain that inflammations may take place, differing most widely in their intensity, their duration, and their seat, without the occurrence of tubercles as a consequence. Tubercles frequently develope themselves without its being possible to prove, either by the observation of symptoms or by anatomical investigation, that their development has been preceded, either by inflammation or by a simple hyperæmia. There are cases where most of the organs are found simultaneously invaded by numerous tubercles, and we cannot conceive under such circumstances that inflammation or congestion, if it had existed, should not have declared itself by symptoms. If there had been antecedent inflammation, how can we conceive the perfectly healthy state of the tissue around tubercles?" (p. 255.) "Alone, and without the

* Compendium de Médicine Pratique, tom. vi, p. 550.

concurrence of another cause," M. Andral resumes, "inflammation, whatever its duration, its intensity, its seat, cannot create tubercular matter; that which determines the formation of this matter is the innate or acquired disposition, in which the inflammation or the simple hyperæmia finds the organism."

According to the views adopted in this work that disposition is —a tuberculous state of the blood. In those cases of acute tuberculosis in which death appears rapidly to succeed the simultaneous occurrence of pneumonia and the deposit of tubercle (p. 265), there must be causes in operation by which the blood is rendered tuberculous before the product of the inflammation can put on the tuberculous character, and before a single tubercle can be deposited. The state of the blood in such cases (p. 266) proves this affirmation; intense pneumonia in an otherwise perfectly healthy subject, produces a state of the blood totally differing from, and even antagonistic of, the tuberculous transformation; and in those tumultuous cases, where inflammation and tubercle appear as it were confused and jumbled together, the condition of the blood differs generally from purely inflammatory blood.

In Sir J. Clark's work this subject is put very clearly (p. 243), and I consider that to him and Dr. Carswell we are deeply indebted for the correction of a two-fold error of a most fatal tendency, but too frequently fallen into even as late as the period at which they wrote; viz., assigning a local origin to "consumption," and attributing that local origin to inflammation.

(*c*) *Pleuritis.*—If pneumonia and bronchitis, diseases so directly affecting the organs of hæmatosis, are totally inadequate to the production of a tuberculous state of the blood, the notion that pleuritis, a purely membranous inflammation, can have the effect, is totally out of the question.

Fournet is the only author that I am aware of who has entertained a different opinion. He states, that in many subjects of very strong constitutions, of the sanguine rather than any other temperament, without the slightest hereditary tendency, or the slightest predisposition to phthisis, chronic pleuritis has given rise to tuberculosis and deposition of tubercle, first in the pleura and consecutively in the lungs. The anatomical facts upon which he founds this opinion have been detailed (p. 192), and they appear to establish that the deposit of tubercle may be primary in the pleura; but he adopts a theoretical argument to explain the production of

the constitutional disease, and the ultimate occurrence of tubercle in the lungs consecutively to the pleural disease, by a *morbid leaven;* a theory for which there is no foundation. Common experience shews that robust constitutions, real or apparent, occasionally become rapidly tuberculous, and it is just in such cases that the anomalous characters of the disease most frequently present themselves.

Although the above considerations belong rather to the history of particular varieties of tubercular diseases, it has been the more necessary thus to establish, that there is not the slightest rational ground for the opinion that the inflammation of any organ or tissue is capable of producing a tuberculous state of the blood, inasmuch as this question of the production of tuberculosis by congestion, irritation, hyperæmia or inflammation, bears very directly upon the history of the occurrence of tuberculosis as a sequence of some of the following diseases.

(*d*) *Specific Epidemic Influences, or the diseases resulting from them.—Influenza.*—Consumption having been observed to become more frequent after certain epidemics, it has been sometimes held that the causes of these epidemics are also the causes of tuberculosis; or that the changes of the economy consequent upon the action of such causes result in this disease. That such an opinion has been entertained respecting measles will be stated subsequently, but it is in reference to influenza that the opinion is most prevalent. The "Annals of Influenza," edited by Dr. Theophilus Thompson, for the Sydenham Society, furnishes most precise information under the present head.

According to Dr. Short the epidemic of 1580, and according to Dr. Huxham that of 1733, sometimes ended in consumption. In Dr. Gray's account of the epidemic of 1782 it is stated that, though from the nature of the symptoms it was with reason apprehended that pulmonary consumptions would be produced in constitutions which seemed predisposed to them, very few such instances were observed, and in many places not one; a few authorities are given who met with cases, but several negative the sequence of consumption in very decided terms.

Huxham states that after the influenza of 1737 many persons dwindled away in a pulmonary consumption, occasioned by the catarrhal fever improperly treated. Of the epidemic of 1803 it is stated that the general testimony was favourable to the opinion that it had a ten-

dency to elicit any existing aptitude to consumption; and when it attacked subjects apparently predisposed, it never failed to increase and call into action the latent seeds of the disease; and in several instances to induce, speedily, a confirmed state which quickly proved fatal. One case is cited of a female, aged 23, and born of consumptive parents, but who at the time she was seized with the influenza, three months previously, was free from any evident phthisical symptoms. Numerous cases of this kind are recorded from various parts of the country by medical practitioners of the highest reputation. Dr. Alderson, of Hull, referred its occurrence, in the lower orders, to inattention to the inflammation along the mucous membrane extending down the bronchiæ; in above 100 of such cases the patients stated, that about six weeks previously they had the complaint, but thought nothing of it at the time. Dr. Mossman, of Bradford, found that seven out of ten of his phthisical patients, after the influenza, dated their complaint from the attack of the epidemic; he believes there was a greater tendency to fatality in the cases originating in the influenza than in those which sprung from other causes, and that remedies did not afford the same relief. Dr. Nelson Scott, reporting from the Isle of Man, states that it manifestly hurried off many who were in different stages of phthisis; thus, in scrofulous habits it was often followed by phthisical symptoms, and when consumption appeared as a sequence, it run to its fatal termination with greater celerity than ordinary. A few observers express a different opinion; Dr. Woolcombe, of Plymouth, was surprised that the complaints of consumptive patients were not affected by it in the slightest degree, nor was phthisis more frequent afterwards, and a practitioner at Reigate met with no instance of phthisis succeeding to it. In Dr. Stretton's Report on the influenza of 1836-37, drawn up for the Provincial Medical and Surgical Association, the following questions and answers appear:—

In persons attacked by the epidemic, who at the time laboured under pulmonary disease, was the latter malady aggravated on the subsidence of the influenza?

"This seems to have been decidedly the case, and, generally speaking, with but few exceptions. According to some of the returns, however, persons affected with certain forms of pulmonary disease would appear to have especially suffered, particularly those labouring under phthisis pulmonalis, and bronchial affections.

Dr. Baird, in his reply, states that it was only the purely phthisical cases which were aggravated on the subsidence of the attack. The testimony of Mr. Appleton, of Evesham, and Mr. Smith, of Stroud, is to the same effect; and Mr. Rice says, that in the only instance of this kind (previous pulmonary disease) which he attended, a case of hæmoptysis, the attack proved speedily fatal. Mr. Bier, Dr. Chapter, and Dr. Clendenning, observed that the attack of the epidemic seemed to hasten the development of phthisis or other pulmonary disease, when it had been previously latent, or when a predisposition had existed." Dr. Hastings, at the same time that he bears testimony to the facts above stated, says—"I may also remark that this is not confined to pectoral complaints. I find muco-gastritis and muco-enteritis of long standing, referred in its commencement by patients to the influenza. Wherever, in short (he continues), any latent disorder existed in the system, the effect of the disturbance of the functions of the body by the epidemic seems frequently to have been to call into activity the disease which had been previously for a length of time dormant."

In two only of the replies is this question answered altogether in the negative; and in one of these, from Mr. Welshman, of Kineton, it is even stated that certain cases of pulmonary disease were decidedly benefitted from the epidemic. "I do not think (he observes) any of my patients who were attacked by the epidemic, who at the time laboured under pulmonary disease, had their former malady aggravated by the more recent affection; two or three who had previously had chronic bronchitis were decidedly free from it after recovery from influenza."

Dr. Hastings refers to a case in which he observed the same circumstance. "In a lady, who has for years been very liable to bronchial attacks, and has for many winters been under the necessity of taking great precautions as to exposure to weather, the influenza came on with great severity, and much aggravation of the usual pectoral symptoms. They did not, however, continue longer than a week, and this lady has ever since that time been more free from pectoral complaints than for three years previously."

These, however, are obviously but exceptions to the general rule.

Added to this, in Dr. Blakiston's recent work on consumption,

it is stated that the number of persons who previously to their suffering from influenza had enjoyed good health, and had presented no traces of a strumous diathesis, but subsequently to the attack became subject to phthisis, was very great.

There is a remarkable uniformity in the recorded results of the influenza prevailing in different years, as respects tuberculous subjects. A careful consideration of the facts leads to the conclusion, that the influenza occasionally acts as an exciting cause of local disease in tuberculous habits, and that it probably acts occasionally also as auxiliary to other more efficient causes where there is no predisposition; but since it does not appear in the widest statistics of the Registrar General that the mortality from tuberculosis is increased in seasons when the influenza prevails, there is no sufficient reason to regard it as a true or direct cause of the disease.

The etiological influence of the influenza most probably depends, on the one hand, upon the depression of the vital powers, which promotes the disease of the blood; and on the other hand, upon the local irritation which promotes the deposit of tubercle.

Rubeola.—MM. Rilliett and Barthez regard measles as a "direct" cause of tuberculosis; 22 out of 314 cases succeeded to this disease, and in many, the relation of cause and effect was so evident as to leave no doubt in their minds on the subject. As in the case of vaccination, they found that a greater proportion of children who had the measles died of tubercular disease than of those who had not; that is to say—of 73 children who had the measles, at some antecedent period, 54 died tuberculous at a more advanced age; and of 170 who had not had the measles, 95 only died tuberculous. Sir J. Clark remarks that severe bronchial disease is often an essential part of measles, and that the measles often becomes an exciting cause of tuberculous disease in persons constitutionally predisposed.

MM. Rilliett and Barthez' statistics are totally inadequate to establish any direct effect of the morbillous poison in producing a tuberculous state of the blood; but when we consider that the cases of tuberculosis supervening on measles occurred in children subjected to hospital hygiene and discipline, they are of very great importance, as illustrating the effects of antihygienic influences over the subjects of this disease, especially during convalescence.

Scarlatina.—Sir J. Clark regards this disease as very dangerous

to young persons disposed to or labouring under tuberculosis; during convalescence the lymphatic system, the pleuræ, and the lungs, are peculiarly liable to inflammatory attacks; and hence, as noticed by Morton, rapid consumption often occurs. (Lib. cit. p. 252.) MM. Rilliett and Barthez hold an opposite opinion: they believe scarlet fever has very little power in retarding or promoting tuberculosis, whether tubercles have been previously formed or not. (Lib. cit. p. 116.) We have no reason to regard this disease, under any circumstances, as a sole cause of tuberculosis.

Pertussis.—Tuberculosis frequently succeeds hooping cough in children, and the local seat of the disease may be the bronchial glands or the lungs; this has been particularly observed in hospitals for children; but MM. Rilliett and Barthez, to whom this observation belongs, remark at the same time, that hooping cough rarely suffices alone (L. c. p. 113). There can be no doubt that in a great proportion of the cases in which tuberculosis succeeds hooping cough, not only a tuberculous state of the blood, but a deposition of tubercles pre-existed; at the same time the anti-hygienic influences to which children are often subjected during this disease, on the one hand, and the mechanical effects of the cough, on the other hand, are sufficient to account for the occurrence of tuberculosis in particular cases, whether the individual be or be not hereditarily predisposed.

Syphilis.—The great question of the relation of syphilis to tuberculosis, as entertained by many early and some more modern writers, has been fully stated (p. 390); but the further question remains, whether syphilis has any influence in producing a tuberculous state of the blood in the individual affected. In the autopsy of 314 tuberculous children, MM. Rilliett and Barthez met with no facts to justify the opinion that this disease is a cause of tuberculosis. We have the advantage of their great experience in support of the conclusion we have arrived at, under the head of "The causes by which tuberculosis may be induced in the individual before birth," that syphilis and scrofula are two different diseases, one of which cannot be the cause of the other.

In a former part of this chapter, *continued febrile action* has been described as one of those morbid processes capable of acting as a predisposing pathological cause of tuberculosis. In truth, the whole of the diseases under the present head might have been treated of under the first division of the present section (A p. 395),

but that a vague notion has been entertained, that several of them have a more direct agency in inducing the disease, and it appeared to be desirable that all the causes to which the disease has been imputed should be brought under consideration, seriatim. Dyspepsia has been more insisted on, by some writers, than almost any other cause, and although one of the most constant *effects* of the disease, even in its slightest forms (pp. 40, 84), it may act as a predisposing *cause* in the non-tuberculous; but dyspepsia has been identified with the proximate cause or essential nature of the disease, and in that point of view will have to be considered in a future chapter.

It thus appears, in reference to the whole of these pathological agencies, to which the production of tuberculosis has been at various times attributed, that no one of them is capable of producing the disease. They are all adequate to the production of a state or states of the blood, and of the constitution generally, which operate as predisposing causes; and by their local effects and complications any of them may act as exciting causes of local tubercular disease. At the same time, it must not be overlooked that the sick, besides suffering from the diseases with which they are affected, are frequently subjected to those anti-hygienic influences which have the most effect in producing a tuberculous state of the blood, and on this account, from having been previously healthy, they may become tuberculous, apparently from the effects of the disease. But the most important point is that this change does not take place during the attack of the disease; from all we know of the pathology of the blood, its condition during most of these diseases is antagonistic of the tuberculous transformation; and it is not until convalescence commences that the latter can occur, a consideration of immense importance in reference to therapeutics, and calling for the most serious attention to the hygienic circumstances under which recovery from disease is conducted.

2. CONTAGION.

Tuberculous diseases have been considered contagious by many high authorities of all ages. Morgagni, Van Swieten, Morton, P. Frank, Hufeland, are most frequently quoted, and the notion cannot be said to be abandoned at the present day. In many countries in the South of Europe, as in Spain and Italy, and particularly in tropical climates, it is regarded as contagious, and phthisical patients

are treated like those affected with the plague; in the whole of the North of Europe and in America it is regarded as non-contagious. The doctrine of contagion has, however, at all times been based on very vague and insufficient evidence; such as isolated cases of the occurrence of the disease in individuals who had previously been in constant attendance upon the sick; or in husbands or wives, where both had slept in the same bed until the fatal termination of the disease in the one first affected. In appealing to these facts as evidences of contagion, no account is taken of the anti-hygienic influences to which the individuals had been subjected, or of the probability of a common or independent source of hereditary transmission, or of the predisposition or the actual disease acquired previously. Against the few facts which tend to support the doctrine of contagion, there are tens of thousands against it.

Albers recorded five cases in which tubercular matter having been deposited on the surface of the denuded dermis, it produced small hard elevations, which are said to have had all the physical characters of tubercles,* but the observations are of no value, since the chemical and microscopical characters of the morbid product are not described. Dr. Malin declared (Gaz. Méd., 1839, p. 634) that two dogs having swallowed the sputa of a phthisical patient for several months, "both died of pulmonary phthisis." This is at best an isolated fact. Laennec stated that he knew of but one fact that appeared to shew that it is possible to give rise to tubercle by inoculation. He was, himself, a tuberculous subject, and died of phthisis at the age of 45. Above twenty years previously a slight graze of the finger with a vertrebra of a tuberculous subject gave rise to the formation of tuberculous matter at the spot, without any other evil consequence. Had Laennec made the distinction between the constitutional state which may continue throughout a whole life without any local manifestation, and the local disease produced by various exciting causes, he would not have attributed this fact to contagion. Dr. Forbes speaks somewhat doubtingly on the subject of contagion, although he admits that among the thousands of cases he had attended he never witnessed one unequivocal instance of the fact.† Opposed to the above statements, numerous experiments have been made by inoculation with scrofulous and tuberculous pus, by Kortum, (De Vito Scrofuloso, p. 218) Lepelle-

* Journ. des Connaissances Méd., 2 an., No. iii, p. 93.

† Translation of Laennec, Ed. 3rd, p. 336.

tier, Goodlad, and others, with negative effects. Not only was no disease communicated to the person inoculated, but there was not even any very evident irritation excited at the place where the matter was inserted.

Andral questions whether it is wise absolutely to deny contagion in all cases. He enquires—who can affirm, with sufficient proof, that a disease which can never be regarded as simply local, and which, in proportion as it advances, presents the characters of a kind of infection of the whole economy, is insusceptible of transmission, in cases where very close and continual approach exposes a healthy individual to the absorption of the miasms disengaged from the pulmonary mucous membrane and the skin of a diseased person? In the course of his own practice he has been frequently struck with the circumstance of women exhibiting the first symptoms of pulmonary phthisis shortly after the death of their husbands, with whom they have slept to the last moment. The question must be, scientifically, very difficult to resolve, in consequence of the great frequency of phthisis; there will always be contrary facts to bring forward, and the value of the positive facts will always be diminished by assuming that the individuals were previously affected; but, practically, these facts have some importance, since they lead to the necessity of taking some precautions with persons who are daily engaged in attendance on phthisical patients, especially during the last stages of the disease.*

By far the greater number of modern pathologists reject in toto the contagiousness of tuberculosis; but all admit the injurious influence of close confinement in the vitiated atmosphere of a room occupied by a tuberculous subject, and of sleeping in the same bed after expectoration of pus and night sweats have set in; to which may be added that attendance on tuberculous patients is too frequently combined with insufficient exercise and mental depression.

Regarded fundamentally as a blood disease, the various tuberculous affections differ essentially from those contagious affections arising from a poison, wherein the minutest particle of the materies morbi, when introduced into the blood, produces matter of its own kind, ad infinitum, until the affection pervades the whole mass of blood, as in small-pox and measles. They differ also from those diseased states which are produced by foreign agents, as antimony, mercury, ergot, or cantharides, which, introduced into

* Traité de l'Auscultation Médiat, t. ii, p. 179.

the blood, act as morbific principles, and produce the effects properly belonging to poisons. Tuberculosis appears rather to be a modification of the natural process of hæmatosis, in which an heterologous arrangement of the elements which compose one or more of the most essential proximate principles of the blood, is produced by some change in the essential conditions of normal hæmatosis. It requires the continuous operation of the causes to produce a continuous effect. Thus, although the blood at any particular period be tuberculous in the highest degree, if the individual be placed under favourable hygienic circumstances, and provided local disease has not set in, healthy constitutional blood begins to be formed, and is gradually substituted for the tuberculous blood, the latter having no power of converting the former to its own nature. A long period may be required for the renewed healthy blood to supersede the tuberculous blood, and it might even be argued, on the principle of the infinite divisibility of matter, that this could never wholly take place, either in the individual or in successive generations; but after a time, and since hæmatosis is a rapid process, after no very great lapse of time, the blood would for all essential purposes be healthy, healthy nutrition being substituted for depraved nutrition.

VI.—COMBINED AGENCIES.

An endeavour has been made, in the preceding sections, to state the evidence upon which certain agencies have been regarded as causes of tuberculosis, to estimate the value of that evidence, and to determine, seriatim, the influence which each may alone be supposed to exert in the production of the disease. Throughout, the difficulty of isolating these agencies from each other has presented itself, and we have been unable to determine the *modus operandi* of any of them. When we arrive at a conclusion that an insufficiently renewed atmosphere has the effect, who, in the absence of ulterior evidence, shall affirm that it is by deficient oxygenation? or, who shall deny the possibility that the effect is produced by some electrical influence? Again, when we regard deficient exercise, or the depressing passions, as the cause, how can we completely isolate these agencies from the defects of the digestive or respiratory functions, with which these always occur, *pari passu*. The truth is, that in the absence of any demonstrative proof of the essential modification of the blood which constitutes tuberculosis,

and in the present imperfect state of science as respects the effects of physical agents and moral influences upon the blood, there is but one truly philosophical or safe course—to keep the facts steadily in view. These considerations have rendered it necessary to qualify the conclusions at which we might otherwise have arrived under every head, and have led us to anticipate some of the remarks which belong to the present.

Dr. Addison very appropriately quotes* from Mr. Mills' *Treatise on Logic*, that, "it is seldom, if ever, between a consequent and one antecedent that an invariable sequence subsists," and applies this principle to the causes of phthisis. I consider it peculiarly applicable to tuberculosis, viewed as a disease of the blood, and to its etiology. A particular proportion or quality of diet may be followed by a tuberculous condition of the blood, and still there may be no invariable connection between such a diet and such a condition. The same may be affirmed of vitiated air. Yet in both these cases there certainly must be some circumstance which took place, or some combination or other upon which the production of the tuberculosis would, invariably, be consequent. As, for instance, a particular diet combined with a particular state of the atmosphere, or both or either with a particular temperature, or state of health, or bodily conformation, or degree of exercise and molecular motion; which combination of circumstances constitutes the condition necessary for the sequent phenomenon—the antecedents which determined it—and but for which it would not have happened—the real cause of tuberculosis.

Apart from the direct practical question which this part of the etiology involves, we thus see the necessity, in a theoretical point of view, of studying the effects of the agencies already treated of, in combination. It so happens that the practical arts and sciences, the modes of life, and the habits and customs of mankind, and the conduct of man in reference to the inferior orders of organized beings, furnish numerous experiments, frequently on a very large scale; and the only thing required is, that he should diligently investigate these experiments, and arrive by the force of his reasoning powers at their true interpretation.

It has been rendered by no means improbable, that deprivation of light, a lower temperature than natural, a damp, vitiated, and insufficiently renewed atmosphere, and improper nutriment, are

* On Consumption, p. 203.

capable of deteriorating the sap of plants, so as to induce the formation of defective cells, followed by aberrations of cell-growth and defective nutrition, analogous to the disease in animals designated "tuberculosis;" a young tree, of a good constitution, transplanted from its native soil, to a confined garden surrounded by walls in the dense atmosphere of a town, where the air is constantly humid and vitiated for want of sufficient ventilation and the genial influence of the light and heat of the sun, is soon found to be in a state of disease, with many of the characteristics of tuberculosis (p. 355). Here is a combination of many of those agencies which are most closely allied, in the relation of cause and effect, to the disease as it occurs in the human race. The effects are probably as analogous as the differences of organization will admit of; and the causes are identical.

Analogous conditions in combination produce analogous effects on the blood and organic structures of animals, most probably throughout the whole zoological scale (pp. 352—5). 1, a vitiated and close, moist atmosphere—2, an unnatural diet—3, deprivation of light—4, confinement and want of exercise, have been employed, experimentally, with success, on various species of animals, to produce a tuberculous state of the blood and the deposit of tubercles. Under similar conditions, tuberculosis is continually produced, spontaneously, in cows shut up in close habitations; and under analogous conditions, including humidity and bad pasturage, in sheep. Again, under a similar combination of circumstances, both carnivorous and herbivorous beasts and birds, from northern and southern climates, die of tuberculosis in the menageries of London, Paris, Calcutta, and other places. In this last instance it has been held, that the effect is due to change of climate, *per se*, and independent of all known anti-hygienic agencies; but in the consideration of the influence of climate we shall see that it is totally impossible to separate the one from the other. The case is precisely the same with the human species. If there is difficulty in determining the fact of the production of tuberculosis under particular influences regarded singly, there is none when we view several of these influences in combination; and here, especially, there is no occasion for any new or direct experiments. Unhappily, man, in his condition of civilization, affords illustrations on the largest scale. It is civilized man, *par excellence*, who is mowed down and his years cut short by tuberculosis; and

it is the habits, customs, and institutions of civilization, which are especially conducive to its production. This is amply illustrated, in an analysis of the facts already detailed, and by those which follow; but at the same time, the remark is due here, that it can in no sense be regarded as a *necessary* result of civilization, it is incidental to the present *transition* stage; to the *period of progress;* and every philanthropist will rejoice in the reflection, that the faculties of man are fully adequate, by moral and physical improvement, not only to abate those evils which he has himself created, but that, under the Christian dispensation, by the progress of human knowledge, he may hope to succeed in totally eradicating this curse.

Athough many facts of great significance and value develope themselves under this head, we have in the main to deplore the deficiencies of science, and in particular, as on many previous occasions, the absence of sufficiently comprehensive statistics.

In the first place, in reference to children, MM. Rilliett and Barthez ascertained that, in a certain proportion of their cases, the disease was referrible, on careful analysis, to a *combination* of several obvious anti-hygienic influences. They give the following summary of facts:—

	In 314 Tuberculous Children.	In 211 Non-Tuberculous Children.
Several anti-hygienic conditions combined - - -	34	16
Several anti-hygienic conditions combined the sole causes	21	8
One anti-hygienic condition - -	31	17
One anti-hygienic condition the sole cause - - -	13	4

Thus, of 50 children dying under the influence of several anti-hygienic conditions combined, 34 died tuberculous, and 16 of other affections; and in relation to 21 of the 34 no other cause could be recognized. Of 48 cases, where a single anti-hygienic cause only could be determined, 31 died tuberculous, and 17 non-tuberculous; and 13 of the 31 did not recognize hereditary influence or any other cause. MM. Rilliett and Barthez remark, that as the ratio of 13 to 31 is much less than that of 21 to 34, we have reason to conclude that a combination of causes produces the disease more frequently than the causes taken singly. Of the 13 cases referrible to one cause only, in some it was bad nourishment, in others bad air, and in others onanism; shewing, in the opinion of the authors, the limited influence of either of these causes taken singly.

This statement and similar ones under other heads are introduced, because it is considered that an approach to a numerical estimate of the influence of the causes of this disease is advantageous, provided we do not suffer ourselves to be misled by the conclusions. This work contains several illustrations of the reversal of results drawn from a limited number of cases, by statistics on a broader scale. But in MM. Rilliett and Barthez' statement, the anti-hygienic influences are manifestly not fully estimated. For instance, we have no account of the mode of nursing and the habits of the children in reference to exercise, yet there is the strongest reason to believe, that a deficiency of exercise is one of the most powerful inducing causes of the disease, even at the earliest age. We believe that it is a cause which exerts its influence from the earliest periods of life. Again, the fact ought not to be overlooked, that of the 211 children who died non-tubercular, we cannot infer the absence of either acquired or hereditary tuberculosis, because they were destroyed by, probably starvation or acute *diseases,* before tuberculosis—even in children a comparatively *chronic* affection—had time to develope itself; and more especially before the actual deposit of tubercle.

The further development of the facts relating to the production of tuberculosis by combined agencies will be best effected under distinct heads.

1.—PRISON DISCIPLINE.

A combination of causes by which a tuberculous condition of the blood is unquestionably produced is found in the conditions which frequently attend imprisonment, the most active of which are: 1. Impure and insufficiently renewed air. 2. Want of exercise. 3. Poorness and deficiency of food. 4. Deficiency of external warmth. 5. Depression of spirits. A most important Letter from Dr. Baly, published in the Appendix to Mr. Phillips's work on Scrofula, most fully establishes the influence of imprisonment in the production, not of external scrofula only, nor of phthisis only, but of tubercular diseases generally. In a period of 18 years, in the Millbank Penitentiary, where the above combination of causes generally was in operation, nearly half the deaths and half the pardons on medical grounds were due to external or internal scrofula or tubercular disease. During one year, the mortality from this disease in proportion to the population of the

prison, is estimated at nearly four times more than the mortality of the metropolis for the same disease. On examining the statistical reports of the Penitentiaries of other countries, Dr. Baly found in them also, that tuberculosis is the principal cause of death; the mortality therefrom being twice or thrice as great among the prisoners as amongst persons of the same period of life in the general population. It is clearly shewn, that this great prevalence of tuberculosis is not attributable to an extraordinary liability to the disease in persons forming the criminal class. Of 510 prisoners, who remained on an average not more than three months in the Penitentiary, only two became scrofulous or consumptive during their sojourn there; but of 520, who on the average were confined from two years to two years and a half, 78 became tuberculous before the expiration of their term of imprisonment. The number of new cases increased gradually during the first 18 months, and then remained nearly stationary, or rather diminished, and the number of deaths, and the pardons from the chances of death, increased at first rapidly, and afterwards more slowly, as the periods of the convicts' imprisonment became more advanced. The effect of the imprisonment was remarkably shewn by the effect of release from the confinement. Prisoners who were even in an advanced stage of consumptive disease, and who in the Infirmary had been gradually and rapidly getting worse, immediately improved. The whole of these facts support each other, and lead to the conclusion, that the sum of the conditions attending the imprisonment was the certain cause of tuberculosis in a large majority of the cases. Dr. Baly, as we think very correctly, does not attach the greatest importance, in this particular case of the production of tuberculosis, to diet, since the diet of the prisoners was at least more abundant than the ordinary fare of the labouring classes. Still, a more generous diet, including a larger proportion of animal food and beer, had in many instances a beneficial influence in checking the progress of the disease; and Dr. Baly remarks, that the "thinnest convicts," and those having the largest proportion of unhealthy and scrofulous individuals amongst their number, came from the Scotch prisons, in which the diet consists of a sparing allowance of vegetables and farinaceous articles, and contains little or no animal food. These facts confirm the principle before laid down, that defective diet will produce poverty of blood and starvation, but it will not alone produce

tuberculosis; it produces a defective pabulum of the blood prone to the tuberculous transformation, and this may be one condition of the production of the disease, but it is not a necessary condition.

The production of tuberculosis by prison discipline, where convicts have been confined for long terms, is further completely proved by Dr. Baly in a most elaborate and important paper "On the Mortality in Prisons."* In England, Switzerland and America, the ratio of mortality from these diseases is twice or thrice as high as amongst the free population of cities; while from no other diseases, or classes of diseases, has the mortality been uniformly, in all prisons, raised above the ordinary ratio amongst the free population. Dr. Baly further deduces from his investigations, that the causes which operate most powerfully in the production of tubercular disease are wholly independent of the locality. It is not the prevalence of pulmonary phthisis only, but of all forms of the "scrofulous cachexia characterized by the deposition of tubercular matter," especially disease of the external glands, which Dr. Baly illustrates. In the Millbank Penitentiary, of 337 pardons, on medical grounds, scrofula formed the ground of pardon in 78 cases; and as aggravated cases only would be considered sufficient to release a convicted criminal from confinement, the prevalence of the disease must have been very great indeed. 37 out of 527 prisoners went under treatment for external glandular scrofula in less than three years. In the Penitentiary of Lausanne, the chief diseases of the prisoners are stated by the physician Dr. Pellis to be a kind of *chlorosis* and *tuberculosis;* and the latter affects the lungs, the intestines, the glands of the neck, the membranes of the brain, and the limbs, "with a relative frequency corresponding with the order in which these parts are here enumerated." In the Eastern Penitentiary in Pennsylvania, in 15 out of 63 fatal cases amongst the black convicts, the prisoners had tuberculous (scrofulous) affections of other parts of the body besides the lungs; "the predominant diseases in that prison were *scrofulous* diseases, dyspepsias, and affections of the chest, including *consumption.*" In New Jersey Penitentiary, according to Dr. Coleman, "the tendency to glandular obstruction is seen in almost every prisoner who has been confined in the cells for more than a year, when he is in the least indisposed; . . . some post mortem examina-

* Medico-Chirurgical Transactions, vol. x, p. 114.

tions have been made, and in all of them the lymphatic glands were enlarged to an enormous degree, indurated and obstructed."

The following table affords a view of the ravages of tuberculosis from prison discipline in the aggregate of many prisons and a large number of prisoners:

TABLE XXII.

	Aggregate of Prisoners.	Deaths from all causes.	Deaths from Tuberculosis.
Millbank Penitentiary (London). . . .	9,588	205	81
16 County Prisons (England)	25,928	499	109
17 County Prisons ,, ...	8,427	181	55
Lancaster County Jail ,, ...	5,011	102	36
Eastern Penitentiary (Pennsylvania). . .	3,737	147	81
State Prison (New York)	9,053	378	102
Auburn State Prison (New York) . . .	8,188	159	81
Charlestown Prison (Massachusetts) . . .	3,059	60	33
Baltimore Penitentiary (Maryland) . . .	1,755	85	50
Geneva Penitentiary (Switzerland) . . .	909	24	11
Lausanne Penitentiary ,, . . .	882	32	6
	76,535	1,872	645

This gives an average of 1 death in 118·7 of the whole number of the inmates in the various prisons, and 1 in 2·9 of the deaths.

In no instance does the proportionate mortality of the general population rise so high; and it may be here remarked, that in the greater number of these cases the diagnosis is verified by post mortem evidence, so that it is not probable that the number of deaths from this cause is exaggerated, whereas the chances are that the number for the general population is frequently represented above the truth.

Dr. Baly's observations illustrate the production of tuberculosis by prison discipline in London in the 51st degree of latitude, and 5 miles west of 0° longitude, and also in America and Switzerland; and they afford some insight of the causes. The following facts derived from the "Pathologica Indica" of Dr. Allen Webb, illustrate the same thing in the jail at Midnapore, in Upper India, in 22° 30″ North latitude, and 87° 25″ East longitude.

In tropical Midnapore, according to the description of Dr. W. A. Green, the building used as a jail is an old Fort, with a high entirely enclosed wall, extending the whole circumference, and

preventing any free current of air through the grounds and rooms; the enclosed area is parcelled into separate spaces by high walls, which must still further obstruct the circulation of air; the basement itself is rock; the climate is comparatively dry, and the heat night and day very great; the air is unchanged by any breeze, although ventilators have been opened in the roofs of the wards (lib. cit. p. 100).

In this jail the Bengalese prisoners are extremely liable to pulmonary affections, and particularly to pneumonia and pleuro-pneumonia, and consumption appears to be produced. The prisoners were generally well, and able to work for an interval after they were received into the jail, and before they exhibited pulmonary symptoms, although for the most part "a cachectic body with comparatively feeble powers of life." According to Dr. Green's report, 14 cases of pulmonary consumption appeared to be generated by the jail discipline, and 175 cases of pneumonia occurred in 14,313 prisoners.

As the ground work of the opinion, of the local origin of consumption amongst the prisoners at Midnapore, and for assigning as its causes the ill-ventilated jail, and the prisoners working at the red hot soil, it is stated, that after a careful examination into the early history and origin of the cases of this disease as they occurred, Dr. Green was led to the conclusion, that many of the men thus affected were previously hale, and capable of earning their livelihood; and were not subject to cough before imprisonment. He found that, after they had been working a few weeks or months on the roads, and inhabiting the jail, they became the subjects of attacks of inflammation of the lungs; and from time to time of frequent repetitions of these attacks, which ended in some cases in recovery, even after several such relapses; in some cases in death in the acute stage, in others in a prostrate sinking state, with a gradual wasting away of the body, and all the symptoms, and ultimately *all the post mortem morbid appearances of tubercular disease of the lungs*. Thus, in reviewing the cases of undoubted phthisis pulmonalis, whether following upon the inflammatory symptoms above alluded to or not, he found that, of nine prisoners suffering under the disease,—in one, pulmonary symptoms were developed on the fifth time of admission, after having been a prisoner for nearly 12 months;—in another, the prisoner worked on the road for 2 years before complaint;—in a third, he appears

to have been well during the first 4 months of his imprisonment before the symptoms shewed themselves;—in a fourth, he was well during the first year in jail, and frequently ailing with fever during the three next, up to the manifestation of the disease at the end of this time;—in a fifth, pulmonary disease appeared at the end of the second year of imprisonment—in a sixth, the prisoner worked well for nearly 2 years;—in a seventh, he remained well in jail performing his daily labour 6 months, and the tubercular disease was not suspected until after the eighteenth month of imprisonment;—in an eighth, after 3½ years confinement, the prisoner having been meanwhile subject to attacks of fever, the disease was first suspected;—in a ninth, although frequently in hospital with fever, at times, during 8 months, yet disease of the lungs did not shew itself by evident symptoms until the eighth month of imprisonment: this man, it is stated, might have brought with him the seeds of the disease, but he was able-bodied and well at home. In these cases, Dr. Green remarks, "it may be impossible to define the precise period of the setting in of the morbid tubercular disposition, or the date of its latent commencement; yet the disease was evidently nurtured by, if not the growth of, the jail, &c. With regard to the existence of any predisposing taint or tendency in the more acute case of pneumonia, &c., there appeared no evidence of such, either in the living symptoms, or post mortem appearances, the men having worked well up to the time of the attack." *

The analogies and the differences in the cases of tuberculosis produced under circumstances, in many respects similar, in various countries so remote from each other and of such different climates, are highly instructive. In the Calcutta Prison we recognize similar agencies in play as in the London Penitentiary, but the one is in a hot climate, where tuberculosis is little prevalent, and the other in a cold, damp climate, where it is very prevalent. In the former case, pneumonia, and acute or subacute phthisis, analogous to that which occurs in the acute phthisis described in this work (Path. Anat. p. 265), or the phthisis of children, appear to be most prevalent; the blood, after one or more attacks of pneumonia, under the influence of anti-hygienic causes capable of producing the disease, more or less rapidly runs into the tuberculous state.

Barrack discipline would appear, from the Army Reports, to be

* Pathologica Indica. Dr. Green's Report, page 108.

closely allied to prison discipline, in its effects upon health and the production of this disease. The British Foot Guards, stationed in London, are in a very great degree more liable to consumption than the general population of London; 14·1 per 1000 died of it throughout a given period, that is to say, more than two-thirds of the whole deaths, while, during the period over which the returns spread, the deaths, at the same ages in the civil population, were not one-third. So, also, in Foreign stations, even where the inhabitants are little liable to the disease, the mortality in the British and United States Armies is very great. It is a curious fact again, that the relative frequency and fatality of consumption in officers and privates at some stations, as in the West Indies, is very different; in the windward and leeward station the admissions were relatively as 6 to 15, and the deaths of the officers one-fourth; in Jamaica the frequency was as 4 to 15, and the deaths among the officers one-fifth of what occurred among the troops generally. These results cannot depend upon climate. The congregation of soldiers into barracks is the main distinction between them and the general population of a place, and between the privates and the officers; hence these facts are brought directly into the category of the effects of a vitiated or insufficiently renewed atmosphere.* There are other causes in play, referrible to their peculiar duties and habits, the depressing passions, sexual vices, and the like, but the most probable cause resides in the air of the barracks.

2. PROLONGED HOSPITAL RESIDENCE AND REGIMEN.

MM. Rilliett and Barthez' experience, of the very large proportion of deaths from tuberculosis in children, has frequently been referred to in this work. These deaths occurred mainly in hospital practice, and a portion of them are referred by the authors to long continued hospital residence as a cause. In nine out of the 314 cases of tubercle, no other cause than this appeared to exist (lib. cit., p. 100). These cases became tuberculous in large airy wards, appropriated to the treatment of acute diseases, in which they remained night and day; whereas, among children who were kept in more confined wards, where the air was much more impure, but who enjoyed the free air of the garden of the hospital, one patient only became so, and he was confined constantly to the ward by paraplegia; from which circumstances the inference is drawn, that it is more injurious to remain constantly in a slightly vitiated

* Brit. and For. Review, July 1839, p. 225.

atmosphere, than to pass a part of the day in a pure air and the night in an atmosphere highly vitiated, and that prolonged residence in hospitals tends to the production of the disease.

This subject is one of undoubted importance. MM. Rilliett and Barthez refer the injurious effects to a poisonous state of the air; they remark, very truly, that a mephitic odour exists in hospitals, produced by exhalations from the bodies of the patients and beds, and from the vessels containing the animal secretions, notwithstanding the best ventilation; the nourishment, in the cases in question, is described as ample, and the wards were free from undue moisture; hence, they observe, the frequency of tuberculosis in children's hospitals is referrible, in part at least, to the air; but it has been shewn, under a former head, that no evidence exists bearing out the idea that a vitiated atmosphere, in the sense of a poisonous atmosphere, produces this disease.

These instances are too limited to justify a conclusion. The nine children who became tuberculous, had passed through various other diseases before tuberculosis developed itself; some had hooping cough, some chronic pleurisy, one chronic nephritis, &c. At the same time, the large proportion of cases which became tuberculous under hospital discipline—314 out of 525 cases, countenances the idea that long continued residence in hospitals, workhouses, infirmaries, &c., is liable, especially in young subjects, to bring into action the tuberculous predisposition if not to induce the disease.

The agencies by which such a result is produced, are nearly, if not quite identical with those which operate in prison discipline. Insufficient renewal of the air, confined respiration, want of exercise, depression of spirits, or deficiency of mental excitement, and very frequently, added to these, a restricted diet.

These considerations affect the question of the propriety of the establishment of hospitals for the diseases of children; a question which has to be dealt with, in the main, as one of a choice of evils; but as respects the locality, the aspects, the construction and the economy of hospitals for children, it is imperative that they should not be overlooked. It would be a great evil to society if it were found practically that such institutions tended to augment and to perpetuate tuberculous diseases.

3. LOCALITY OF HABITATION.

This also implies combined agencies as respects hæmatosis; as air, water, temperature, humidity, currents, and the like.

A town and country residence have been compared, as respects the frequency and causation of tuberculous diseases. M. D'Espine ascertained, that in the canton of Geneva, of 680 deaths from tubercles, in four years, 363 were citizens, and 317 country people; and of 83 deaths from scrofula, 52 were citizens, and 32 country people. (Lebert, lib. cit., p. 72.) Mr. Phillips finds, on the contrary, a much greater mortality from scrofula in the country districts than in towns, in England, the proportion being as 97 to 50; and in another order of facts, the proportion of 1 in 12,000 living in country districts, to 1 in 25,000 in manufacturing districts. We repeat our remark here, that the statistics of the mortality of these varieties of disease are not the statistics of the respective diseases, nor are the statistics of scrofula and phthisis, the statistics of tuberculosis. Again, the influence of a town or country residence is not, in these statistics, isolated from other influences which concur with locality. The residents of the country, in the mass, when local disease sets in, such as the various external scrofulous affections, cannot so readily command medical and surgical assistance, and are more apt to neglect the early inroads of fatal attacks; this and many other points must be considered, before we allow statistics to lead us into the belief, that the vitiated air of towns is not concerned in the development of tuberculosis.

4. POVERTY AND RICHES.

Some facts recorded by M. D'Espine, of Geneva, and referred to by Lebert, on the relative frequency of phthisis and scrofula in the poor and rich, speak volumes as to the causation of tuberculosis. The mortality from scrofula being in the general mortality $^{24}/_{1000}$, the mortality from the same cause in the rich is only $^{6}/_{1000}$, while in the poor it is $^{34}/_{1000}$. The general mortality from tubercle being $^{155}/_{1000}$, the mortality from the same cause in the rich is but $^{68}/_{1000}$, while in the poor it is $^{233}/_{1000}$. So also, Lombard, combining the statistics of Vienna, Paris, Hamburg, and Geneva, found the poorer classes of society more frequently affected with phthisis in the ratio of two to one. In connection with this result, let any observer examine critically any number of boys and girls of a London charity school, with a view to determine the proportion in which the tuberculous predisposition, in a more or less marked form, has developed itself, and compare them with an equal number of the children of the more affluent classes, met with in the parks and

gardens of the metropolis, and at once it must be seen in which class tuberculosis predominates. The vitiated atmosphere alone, in which the poor reside, has manifestly great influence in the production of this result; defective diet must also have its effect. The poor are subject to the most complicated combinations of anti-hygienic circumstances, most of which have been at one time or other regarded as the causes or the preventives of tuberculous diseases. The problem in relation to the poorer classes has by no means been worked out in any country. We find them subject to —an atmosphere, excessively hot or cold, or dry or moist, or pure or vitiated—a diet, sufficient or insufficient—duties excessively laborious or completely sedentary—a state of mind, gloomy or cheerful—secretions, forced or suppressed—sexual habits moderate, immoderate or unnatural—several of which causes combined may be the most efficient in the production of the disease of the blood, and others may exist as counterbalancing agencies, but we have no sufficient data to determine the relative effects of each, or the true cause of the excess of mortality.

5. OCCUPATIONS OF LIFE.

Occupations which subject the individual to unnatural and unhealthy modes of life, particularly those which tend to impair the respiratory function or the digestion and the functions of the alimentary canal, to etiolate the body, to exhaust or depress the vital powers, to produce melancholy and depression of spirits, and otherwise to contravene the necessary condition of hæmatosis, are of unquestionable power and influence in the production of that condition of the blood which predisposes to tuberculosis, and they are probably of equal power in predisposing to the invasion of some other diseases. The great question here is—whether they have, of themselves, the power of inducing the tuberculous transformation of the blood? and if they have, by virtue of what agent, or what combination of agents, is the effect produced? Under this head we are in a special manner called upon to distinguish between the causes of the constitutional disease and those of its local development, inasmuch as many of these occupations involve both; and we frequently meet with whole classes of individuals subject at once to anti-hygienic influences, adequate to the production of tuberculous blood, and to the exciting causes of cutaneous affections, ophthalmia, glandular diseases,

affections of the mucous surfaces, the viscera, and the like. Louis has justly said, that the influence of trades, professions and occupations of life generally, over the production of phthisis, is one of the most complicated and difficult of problems which the pathologist can propose to solve, a multitude of the most important circumstances requires to be taken into consideration; and the remark here forces itself upon us again, that as a main result, tuberculosis, and all its fatal consequences, is produced by the occupations and modes of life incidental to man in his present state of civilization.

M. Benoiston made an attempt to determine, on statistical data, the influence of occupations over the production of tuberculosis (phthisis pulmonalis).* The investigation was very limited, many of the most important occupations being omitted; no distinction was drawn between the causes of the constitutional disease and those of its local development, and the enquiry embraced only one form of the disease; the results accordingly are most imperfect, and they contain many contradictions. Subsequently, M. Lombard published some observations of more importance, but still referring only to phthisis, and wanting the distinction just referred to.

There can be no doubt that the prevalence of phthisis is to a certain extent a measure of that of tuberculosis, but, as before insisted on, it must not be taken as absolutely so.

In the Report of the year 1849, of the Hospital for Consumption at Brompton, several tabular views are given, from which the following are extracted:—

TABLE XXIII.

Shewing the trades and occupations of 4,358 *Patients labouring under phthisis, treated as In and Out-Patients, from September,* 1842, *to December* 31, 1848.

MALES—Total, 2,679.

In-Door.		Out-Door.		Mixed.	
Clerks, Warehousemen, and Shopmen	314	Labourers of various kinds	490	Carpenters	120
Mechanics	270	Coachmen and Cabmen	109	Painters and Glaziers .	73
Servants ...:	237	Butchers	15		
Tailors	192	Various occupations ...	184		
Shoemakers	127				
Printers and Compositors	104				
Weavers and Glovers ...	22				
Bakers	45				
Various	146				
None, or under 15 ...	234				
Total In-door ...	1,688	Total Out-door ...	798	Total Mixed ...	193

* De l'influence de certaines professions sur le dévélopement de la phthis. pulmon. Ann. d'Hygien., t. vi, p. 5.

Table XXIII (*continued.*)

FEMALES—Total, 1,679.

In-Door.		Out-Door.		Mixed.	
Servants, or persons engaged in in-door occupations	836	None.		None.	
Milliners, Dress-makers, Needlewomen, and Straw-bonnet Makers	312				
Laundresses	82				
Governesses	10				
No occupation, or under 15	439				
Total In-door ...	1,679				

For the purpose of comparing the influence of occupations in promoting or counteracting tuberculosis (the tendency to consumption), the following table of the occupations of non-phthisical patients attending a general hospital is annexed to the former, the number being exactly one half the number comprised in the last table:—

TABLE XXIV.

Shewing the occupations of 2,179 *cases relieved at a General Hospital, as Out-Patients, excluding cases of phthisis.*

MALES, 885.

In-Door.		Out-Door.		Mixed.	
Clerks, Warehousemen, Shopmen, &c.	26	Labourers of various kinds	94	Carpenters	32
Mechanics	81	Coachmen and Cabmen	30	Painters and Glaziers	33
Servants	38	Butchers	4	Various	66
Tailors	51	Various	42		
Shoemakers	42				
Printers and Compositors	9				
Bakers	9				
Weavers	4				
Various	97				
None, or under 15 ...	227				
	584		170		131

FEMALES, 1,294.

In-Door.		Out-Door.		Mixed.	
Servants, or persons engaged in in-door occupations	833	Various, as Fruit-women, &c.	20	Various	5
Milliners, Needlewomen, &c.	169				
Laundresses	55				
None, or under 15 ...	212				
	1,269		20		5

In the Report, it is remarked by the physician of the latter institution, that on comparing the apparent influence of in-door and out-door occupation over the production of phthisis, with their apparent influence over the production of other diseases, the facts

do not warrant the inference that in-door occupations, of themselves, have a greater tendency to produce consumption than any other disease. Thus, at the consumption Hospital, the in-door occupations of the males and females furnished 77 per cent. of the whole number of cases; at a general hospital, 85 per cent. At the Consumption Hospital, out-door occupations furnished 18 per cent. of the whole; and at a general hospital, 9 per cent.; so that the patients at the Consumption Hospital derived from in-door occupations were 8 per cent. less, and those derived from out-door occupations 9 per cent. more than at a general hospital. This, surely, tends to prove only, that in-door employments, in comparison with occupations out of doors, produce more diseases than one, and not to invalidate the positive figures first given and confirmed by observation from several sources.

With a view to assist in forming an opinion of the influence of particular occupations in producing tuberculosis, I introduce yet another table from the same excellent report (l. c. p. 16).

TABLE XXV.

Shewing the relative proportion of persons following particular occupations, to the whole number of cases, at the Consumption Hospital and the General hospitals, respectively.

MALES.	Per Centage of 2,679 Male Patients at the Consumption Hospital.	Per Centage of 885 Male Patients at a General Hospital.	MALE POPULATION OF LONDON 800,000. Number of Persons engaged in these Trades and Occupations in London.
Labourers, Out-door ..	18·2	10·6	50,000
Clerks, Warehousemen, and Shopmen	11·7	3·0	
In-door Servants	8·8	4·3	40,000
Tailors	7·2	5·8	20,000
Shoemakers	4·7	4·7	25,000
Carpenters	4·4	3·6	18,000
Coachmen and Cabmen ..	4·0	3·5	
Printers and Compositors	3·9	1·0	6,600
FEMALES.	**Per Centage of 1,679 Female cases at the Consumption Hospital.**	**Per Centage of 1,294 Female cases at a General Hospital.**	**FEMALE POPULATION, 1,000,000.**
In-door Servants and Persons engaged in Domestic Occupations ..	49·8	64·3	130,000
Milliners, and Persons similarly engaged ..	18·6	13·0	21,000

Printers and Compositors, in London, furnish patients to the

Hospital for Consumption in the proportion of 3·9 per cent. and to a general hospital in the proportion of 1 per cent. They stand among the highest also in MM. Benoiston's and Lombard's lists. The inference is that they are more liable to consumption than to other diseases, in the proportion of nearly 4 to 1. In *Clerks and Shopmen* the proportion is nearly the same as the last, viz. 4 to 1. Two in-door *Male Servants* apply to the Consumption Hospital for one to a general hospital. *Tailors* in the proportion of 7 to 6. *Needlewomen* and *Milliners* furnish 18½ per cent. of all the females attending the Consumption Hospital, and 13 per cent. of the sick at a general hospital. These statistics, limited and imperfect as they are, speak volumes. In none of these cases are the different classes subject to any special irritating or other exciting cause of injury to the lungs. They shew that in some of these occupations the occurrence of tuberculosis is fearfully frequent; in others, as in needlewomen and milliners, not only consumption, but other diseases, are nearly equally so; the individuals following these occupations are for the most part engaged in sedentary occupations, in a vitiated atmosphere, during the day, they generally breathe a vitiated atmosphere in close lodging houses throughout the night, and they take little or no recreative exercise—circumstances conspiring to produce an insufficient renewal of the air within the chest, and an habitual deterioration of the residual air continually required for the process of respiration. This is peculiarly exemplified in printers, compositors, clerks, shopmen, tailors, shoemakers, needlewomen, and milliners. The little exercise which shopmen take is totally inadequate as a compensating agency, and the whole of the facts tend to establish the direct effect on the blood of the causes of tuberculosis, independent of any primary local affection whatever.

In Dr. Guy's "Contributions to a knowledge of the influence of employment upon health" (The Statistical Journal,) it appears from an analysis of the General Registry for 1839, and of the out-patient books of King's College Hospital, that the two classes of labouring men and tradesmen, under 40 years of age, are twice as liable to pulmonary consumption as the class of gentry, and the difference between the first two classes is very trifling; the ratio of deaths from consumption to those from all other causes being respectively as 1 to 2¼, 1 to 2½, and 1 to 5; that tradesmen who die of consumption die at an earlier age than either the gentry or

labourers; and that the ratio of deaths from consumption to the deaths from all other diseases, in those who follow in-door and out-door employment, are respectively as 1 to 1·98 and 1 to 2·56, or in round numbers, as 1 to 2 and 1 to 2½.

From the statistics before us, imperfect as they are, we are enabled to draw some general conclusions :—

1. M. Lombard found in Paris, Geneva, Vienna and Hamburg, that there are a greater number of persons leading a sedentary life afflicted with phthisis than of those leading an active life, in the proportion of 141 to 89. The inference is that tuberculosis is produced more frequently in a sedentary than in an active life.

2. In Paris, Geneva, Hamburg, and Vienna, phthisis is twice more frequent in those working within doors than in those working in the open air. In the Hospital for Consumption, at Brompton, the relative liability was found to be 63 per cent. of in-door males to 30 per cent. of out-door, and all the consumptive females followed in-door occupations. Dr. Guy found the proportion of deaths in the former class, in London, as 37½ to 25 of the latter, under 30 years of age; and as 61 of the former to 53 of the latter, under 40 years.

3. Phthisis occurs at an earlier age in men following in-door occupations than in those following out-door occupations; the same rule holds good with regard to the deaths from consumption. (Dr. Guy.)

4. A bent posture appeared to M. Lombard to augment the frequency of the development of phthisis. When we consider the malformation of the chest in the predisposition to tuberculosis, and the dyspeptic symptoms which so frequently attend the disease, even in its slightest shades, there can be no doubt of the injurious tendency of bent and constrained positions of the body. The habitual subjection to this influence may also be regarded as ancillary to sedentary employment, or an insufficient renewal of the air, or defective diet, or the depressing passions, singly or combined, in the production of the disease in originally healthy constitutions.

5. The influence of want of exercise over the production of tuberculosis is especially manifest in those who follow occupations confining them within doors. The ratio of cases of tuberculosis pulmonalis to cases of all other diseases is highest where the amount

of exercise is least, and lowest where it is greatest, and an intermediate degree of exertion presents an intermediate ratio; the same ratios, in reference to exercise, is found in the mortality; also the age at which the attack takes place and that at which it proves fatal, is earlier in employments conducted with little exertion than in those requiring more, and in those conducted with moderate exertion than in those demanding great effort. (Dr. Guy.)

6. In the class of in-door occupations with varied exercise, (a class including the footman, waiter, &c.) the ratio of cases of tuberculosis pulmonalis ranks next to that of the sedentary. (Dr. Guy.)

In considering the influence of occupation over the production of tuberculosis, it is most essential to avoid falling into the misapprehensions which have too frequently resulted from the diseases of artisans not being accurately defined by writers on the subject, but every variety of chronic pulmonary disease being set down as consumption. Among the influences which tend to excite local disease, are, exposure to high and low temperatures, sudden vicissitudes of temperature and hygrometrical conditions, violent bodily exertion exciting to excessive cutaneous action, and the consequent liability to sudden arrest of perspiration and vicarious action, the inordinate use, under several of these conditions, of diluting fluids, the use of alcoholic fluids, and most especially, irritating particles floating in the atmosphere. Individuals whose occupations subject them to these influences are thereby rendered liable to pulmonary attacks, and if they inherit a tuberculous predisposition, or are at the same time subjected to those influences which are capable of producing a tuberculous condition of the blood, they are precipitated into phthisis pulmonalis, or some other form of tuberculous disease; but these influences alone, cannot produce tuberculosis.

Stone masons, miners, coal heavers, flax dressers, workers in cotton, needle pointers, those who inhale silex in a minute state of division, as the manufacturers of gun flints, and others engaged in analogous operations, die prematurely of pulmonary affections; but the investigations of Dr. Alison, Dr. J. Forbes, Dr. Johnstone, M. Thackray, Dr. Calvert Holland, and others,* have shewn conclusively, that the diseases they die of are not always tuberculosis. It is quite true that tubercles are developed in some of the cases,

* Sir J. Clark on Consumption, p. 170.

but in perhaps a majority, bronchitis and various pathological results of that disease, are the causes of death. Thus it is, that the statistics of MM. Benoiston, Lombard, and Villermé,* of the diseases of artisans, present so many anomalies and contradictions —they have omitted the pathological anatomy in their enquiries. The "grinder's asthma" has frequently been set down as tuberculosis. The workers in cotton in France are subject to a pulmonary affection which has been erroneously included in the statistics of tuberculosis (M. Villermé). "La maladie de St. Roch," produced by particles of silex in the manufacture of gun flints, is another example. In many of these cases death may be produced by chronic bronchitis from mechanical irritation, but tuberculosis does not occur in any of them without the intervention of other causes.

This subject has been very clearly put by Sir J. Clark, as between the causes of the "tuberculous cachexia" and those of bronchitis (lib. cit. p. 193), but not quite so distinct a line of demarcation is drawn as in the present work, in which the general affection is regarded as an idiopathic disease of the blood, and the above pulmonary affections as primarily local diseases. Sir J. Clark gives a good illustration of the difference in the result where one set of causes is in operation alone, and where both sets of causes are in play—the Sheffield grinders, exposed, together with the exciting causes of local disease, to the confined and deteriorated atmosphere of the town, die between the ages of 28 and 32 years, while those who are employed in the same occupations in the country, generally attain the age of 40 years.

M. Parent-Duchâtelet has shewn that healthy individuals do not become affected with tuberculosis from working habitually in an atmosphere surcharged with fine dust or powder. His observations apply to various dusty occupations. He found that any healthy individual may live with impunity in an atmosphere so full of dust that one could scarcely see, where individuals predisposed to phthisis, or already phthisical, could not exist.†

In Dr. Calvert Holland's account of the various classes of grinders in Sheffield, we have a very clear account of the diseases of the respiratory organs which affect the artisans of that town. The mechanical irritation of the pulmonary surfaces produces

* Annales d'Hygiene, t. xxi, p. 353.

† Ann. Hygiene, t. x, p. 69.

various forms of disease, and death from various causes, and although tuberculosis is a frequent result, in a great proportion of cases it does not occur. Where it does occur, it appears to be the result of other causes superadded to the mechanical irritation. The irritation is very slow in producing its effects in robust constitutions, and after death indurated and condensed lung, dilated, thickened and ulcerated bronchi, occur, without tubercle; but where the tuberculous predisposition exists, the disease is more rapid, and tubercular deposit occurs. The worst cases are where the local exciting cause is accompanied with the greatest poverty and wretchedness, implying bad air, insufficient diet, the depressing passions and intemperate habits; here irritation of the bronchi and lungs occur coetaneously with tuberculosis of the blood, and phthisis is the result, although differing very considerably in its course from ordinary tuberculosis pulmonalis.

How much these causes of disease of the blood have to do with the result is shewn by the following important part of the history: Dr. Holland states—"the injurious effects of the occupation belonging particularly to dry grinding, and the evils which it produces, are comparatively of modern origin. Previous to the employment of steam as a propulsive power, all grinding wheels were situated on the rivers in the neighbourhood, at a distance varying from two to five miles, and in the midst of scenery, exquisitely picturesque and beautiful. The consequence was, that, whether the grinder were resident in the country or the town, he had the advantage of an abundance of fresh air and daily exercise. Besides these circumstances, which are well calculated to preserve the animal system in health, he had frequent holidays, from the supply of water being either too great or too small, so that his application was less continuous than under the new system, which has none of these interruptions." *

Under this head, again, we have to lament the deficiencies of statistical science. No more important question to the interests of humanity can well be started than the one before us; but for the purpose of solving it we require as data—1. The number of individuals engaged in each occupation, with as much information as possible as to their ages, family history, &c. 2. The number of individuals affected with tuberculous diseases generally, and with each important variety, at epochs and in periods of life. 3. The number of

* Diseases of the Lungs from Mechanical Causes. 1843.

deaths from tuberculous diseases, and the total number of deaths from all diseases in each occupation. 4. The number of deaths in the inhabitants of the locality generally from tubercular diseases, and the total number of deaths from all causes. 5. The particular influences to which each occupation or mode of life subjects the individual. 6. A very full account of the pathological anatomy in fatal cases. In the present state of science it is impossible to obtain these data upon a sufficiently extensive scale, but the nearer we approach it the more demonstrative will the science become, and with the greater certainty of success will remedies be applied.

Factory labour.—In this country, even in a political point of view, there is no more important sanitary question than the influence of our factory system over the health of the workmen. A general opinion has prevailed that factory labour is especially injurious to health and longevity, but Mr. Phillips has, I think, shewn that, as compared with other anti-hygienic influences, this view is at all events exaggerated. If, he states, there be anything peculiarly injurious to life in factory towns or labour it is not made apparent in the mortality tables or the returns of friendly societies (lib. cit. p. 227); and the mortality in these towns presses as much upon those not engaged in factory labour, masons, shoemakers, and tailors, for instance, as upon the manufacturers.

Baudelocque imputes to factory districts a large amount of tuberculosis, owing to small and ill-ventilated workshops, and believes that by viciously disposing the places of labour we may multiply the disease at will. Lugol, consistent with his theory, denies that the influences in question have any effect whatever. Mr. Phillips has, I think, set this question in its true point of view; he brings clear evidence that in factory towns, the external population suffer more from external tuberculosis and probably more from tuberculosis generally than those engaged in the factories. Villermé had remarked, that, even in factory districts, it is upon those who are not employed in factories that the mortality falls with most severity; they are more exposed to misery and want, and equally to noxious local influences, while the earnings of the factory labourer give him the means of overcoming many of the noxious agents under which the idle, or irregularly employed, or very poor, would sink.

The truth is, that the influence of occupations of all kinds, and this especially, in relation to their effect upon the blood and the

production of tuberculosis, must be regarded in detail. A man and his wife and a family of children engaged in a factory, with a certain daily amount of exercise, an ample supply of food, and comparative contentment of mind, will be much less likely to become tuberculous than the same family living at home, probably day and night, in a close habitation, with uncertain employment, deficient and irregular exercise, a precarious supply of food, and the continued operation of mental distress. The adequacy of these influences to produce the disease of the blood, in the latter case, is unquestionable. In the former case, the regular healthful mental excitement, and moderate exercise of the body, promote the continual renewal of the respiratory air within the chest, and may even counteract the effects of the vitiated atmosphere of a large town, aggravated by the indifferent ventilation of a factory. In taking this comparative view, we need not overlook the positive evils of excessive labour in close workshops, but regarding tuberculosis as a disease of the blood, the occupation and habits of the poor in former times, before our factory system sprung up, and at the present time, in localities where factories do not exist, are under many circumstances much better calculated to produce the disease than factory labour.

A Military or Naval Life.—A sea-faring life has long been recognized as exerting a favourable influence over tuberculosis. According to the Reports of the British Naval Surgeons at the North American and West India Stations, there are about five attacks of consumption per 1000 men and only two deaths, which, as compared with the frequency of the disease either in civil or military life, is extremely low. It has to be borne in mind, however, that sailors are engaged in the service for a comparatively short period, and that when sick they are very soon sent home invalided, so that we can arrive at no conclusive deductions from these facts. A military life has manifestly the effect of increasing the amount of tuberculosis in those who follow it. The troops of every class stationed at home die of it more frequently than the general population. According to Colonel Tulloch's statistics, drawn from the War Office Returns, the deaths from consumption, in the troops stationed at home, bear the proportion of about 2 to 1 of the general population at the same ages; and having shewn that this excess is not attributable to cold or other atmospheric influences, nor to the abuse of spirituous liquors, Colonel Tulloch

leans to the opinion that a number of men aggregated together into one apartment in barracks, is probably closely connected with the etiology. (p. 492.)

The same thing occurs at most of the foreign stations, and is also exemplified in the Continental and American Armies. This has been attributed to the effect of climate, but we shall see reason, as we proceed, to conclude that it is owing, mainly, to the hygiene of a soldier's life, a subject which will be found more fully illustrated under the head of "climate."

6. SEASON.

That there is no relation of cause and effect between the season of the year and the occurrence of tuberculosis is a tolerably clear deduction from recorded facts. There is a general opinion that both scrofula and phthisis occur more especially in the spring and autumn, or the cold season of the year, and that, when the general disease has set in, the local affections are aggravated at these seasons; and there can be no doubt that under special circumstances this takes place. Thus—in the Millbank Penitentiary, Dr. Baly found that the first symptoms of scrofulous disease, in by far the larger number of instances, appeared during the cold season of the year, and that the disease, if previously existing, always became aggravated at that season; and, accordingly, the greatest number of deaths and pardons due to scrofulous disease occurred during the spring and summer months, and the smallest number during the autumn and winter months, in the proportion of 175 to 74.

With respect to phthisis—Statistical results on a limited scale frequently shew a preponderance of cases, or of deaths, at particular seasons, thus, in Dr. Thompson's statistics of Glasgow (The Northern Journal) the deaths were most numerous in the winter season, and in some of the statistics of the United States and other localities the same result appears, but of 277 patients interrogated by M. Louis, in 137 the first symptoms were reported as having occurred during October, November, December, January, February and March; in 140 they occurred during April, May, June, July, August and September. M. Briquet found, of 98 phthisical patients, 30 presented the first symptoms in December, January and February; 24 in March, April and May; 23 in June, July and August; 21 in September, October and November. Of 412 cases of phthisis occurring in the United States' army, during a

period of ten years, 207, or 4 4/10ths per 1000, originated in the winter season, and 205, or 4 3/10ths per 1000, in the summer season. (Forry, lib. cit.) In Tables VIII and IX (p. 370) it appears clearly that in 56,338 tuberculous subjects, including the phthisical, scrofulous, mesenteric, and hydrocephalic, season had no marked influence over the mortality; according to the first mentioned Table, during five years, 11,874 cases of tuberculous disease terminated during the quarter ending in March, 11,932 up to June, 11,699 to September, and 11,010 during the quarter ending in December, and the registrar-general's reports generally confirm this conclusion.

There can be no doubt that something specific in the prison discipline, totally apart from the influence of season, produced the result determined by Dr. Baly, who very appropriately mentions, "the greater foulness of the air breathed by the prisoners during the winter, when they, in the endeavour to exclude the cold air from their cells, kept their windows continually closed;" although he attributes a great part of the effect to the direct influence of cold.

7. CLIMATE.

Inasmuch as that tuberculosis prevails in variable degrees in different regions and countries on the face of the globe, a very general opinion prevails that climate is in itself a cause of the disease. To such an extent has this opinion been carried, it has even been maintained that climate is the only influence capable of inducing it, and that in all other cases it is derived by hereditary transmission from parents; the influence of climate being regarded as something totally distinct from any of those known anti-hygienic causes to which the disease is more usually attributed, and in conjunction with which climate itself is more generally believed to produce the effect. With those who have not taken this extreme view, climate is still regarded as a very powerful cause, and change of climate, as an etiological, prophylactic and curative agent. Viewed etiologically, the subject naturally divides itself into—1. The geography of tuberculosis—2. The effects of change of climate—3. The qualities of climate which affect the prevalence and fatality of the disease.

1. *The Geography of Tuberculosis.*

Notwithstanding all the labour that has been bestowed, and all

that has been written, we have no sufficient data upon which we can found a comprehensive geographical chart of the absolute or the relative frequency of tuberculosis in different countries and climates. This arises from various obvious causes. Even where registers are kept and published to the world there is a great want of uniformity in the systems adopted, and where individuals have bestowed great pains over the subject their investigations have generally been limited to a particular form of the disease. One individual writes on the prevalence of scrofula, and another on that of pulmonary phthisis in particular localities, both omitting all consideration of mesenteric phthisis, tuberculous cerebral affections, and the like. As regards many countries, it is totally impracticable to obtain any numerical data whatever, yet the general statements of observers are important, and must not be overlooked. The information relating to this part of the subject is extremely scattered. Again, meteorological data are essential in forming estimates of the effects of climate in health and disease, and this branch of science is still very imperfect. At present, very general observations are being made, with greatly improved instruments, corrected to uniform standards, and we may justly expect, under this head, a very great accession of positive knowledge at no very distant period. The whole subject of the geography of tuberculosis, viewed in its present state, is calculated, partly owing to its extent and comprehensiveness, to impress us with the deficiencies of knowledge, although the mass of facts extant is extremely large. Any attempt to give a full account of these would occupy a volume of itself.

Andral collected statistics of phthisis, according to latitude, from which it appeared that the disease is comparatively rare from 50° to 60° North latitude; from 45° to 50° it augments in frequency; from 35° to 45° its frequency varies so much in different countries and localities that no general expression can be given; and from 10° to 20° the same remark is applicable, but as the climate of a country by no means corresponds with the latitude it is better to take another ground of comparison.

The *Isothermal lines* suggested by Humboldt form a better division for our present purpose. If we take the Torrid Zone, bounded by the isothermal lines of 70° from the warmth equator, or line of the greatest mean annual warmth—the temperate zones, comprising the regions between the isothermal lines of 76° and 30°, north and south—and the frigid zones, comprising the regions below the

isothermal line of 30°, or those of permanent frozen ground—there appear to be relative differences as to the liability to the disease; although the actual temperature, measured by the mean, being but one of numerous elements of which climate consists, it is impossible to adhere strictly to any division of this kind, nor is it of great importance.

(*a*) *The North Frigid Zone.*—We have no accurate information as to the diseases or the causes of death of the Esquimaux tribes of Greenland, or of the population of Spitzbergen, of Russian America, or the regions north of the country inhabited by the maritime tribes of North-Western America; but from the accounts of voyagers and travellers, authors have been led to believe, that in some at least of these races tuberculosis occurs, but is a rare disease.

If we take those regions of the temperate zone, which border nearest on the limit of permanent frozen ground, that is to say, from the line of 30° to 40° mean annual temperature, all the testimony before us leads to the conclusion that tuberculosis is comparatively a rare disease. In the most northerly inhabited portion of the continent of North America, in Iceland, the northern districts of Sweden, Norway and Lapland, the testimony of medical observers and historians, including Dr. Thorstenson, who practised in Iceland seventeen years, Lord Molesworth, Professor Retzius, Dr. Roberts, Dr. Schleisner, Linnæus, and others, the disease, whether in the form of scrofula or phthisis, is comparatively rare, and from the whole of the testimony we may even say, as respects the most northerly districts, very rare.

In *Russia,* a great proportion of which is comprised between these two lines, including St. Petersburg and Moscow, according to the older writers in the Philosophical Transactions, the disease has ever been much less frequent than in Britain, and this fact has been more recently confirmed by Sir A. Crichton and Sir G. Lefevre. In St. Petersburg and Moscow, with a mean temperature of about 38° Fahr., scrofula is more common than in England and commits great ravages; its attacks are mostly confined to the external glands, the face, eyes, throat and bones of the extremities, but it rarely affects the lungs. It is an important fact, that those who bear about their necks scars from scrofulous ulceration, are supposed in this country to be almost exempt from consumption. (Phillips, p. 74.)

From a note in Dr. Baly's paper "On the mortality in prisons," (lib. cit., p. 236) it would appear, that in the prisons in *Norway*, there is a very low mortality, owing to a small number of deaths from consumption; and since these prisons are not better regulated than our own, but rather worse, the presumption is, although the returns are little to be depended upon, that the climate of Norway is unfavourable to the development of tuberculosis.

(*b*) *The Torrid Zones.*—Passing now to the meteorological torrid zone, with a mean annual temperature from 70° to 88°, the latter being the mean temperature of the hottest part of the interior of Africa—a region including the greater part of South America, nearly the whole of Africa, all the countries and islands constituting the southern parts of Asia, and rather more than the northern half of Australia—here, as in the case of the colder countries, tuberculosis is also rare when compared with temperate climates, but there are some remarkable exceptions and a great want of uniformity.

In Northern Africa, with a range of temperature a little above and below 70°, all the accounts rendered by native and European physicians, and other authorities, tend to shew a remarkable comparative exemption from the disease in any form; not only amongst the natives of the different countries, but amongst foreigners residing there for any period.

Egypt, and especially *Upper Egypt*, as respects climate, is warm, dry and tolerably equable; it is one of the few favoured spots on the surface of the globe in which the native inhabitants have been represented as enjoying almost an immunity from tuberculosis; its salubrity in this respect having been recognized as long ago as the age of Pliny. Of the infrequency of the disease in any form there can be little doubt, but, notwithstanding the qualities of the climate, anti-hygienic influences are capable of producing it here as elsewhere. Mr. Kaye found marks of external scrofula on 2 out of 52 children, and in the villages on the Nile, where the children are naked and dirty, living in huts where the pure air had neither ingress nor egress, except through a small hole near the ground, and on a very poor diet, this form of the disease occurs. (Phillips.) Most of the children were also observed to have enlarged abdomens, but no account of the pathological cause is given. All the writers on this country, from the earliest to the latest times, concur in their accounts of the infrequency of con-

sumption, attributing this, according to their particular views, to one or more of the qualities of the climate already mentioned. There is also a general accordance as to the salutary tendency of a residence in the country by consumptive patients, notwithstanding which the negro race from the interior of Africa, and the natives of Nubia and Abyssinia, where phthisis occurs even more rarely than in Egypt, are frequently affected with the disease.

In *Syria* also, from the best accounts before us, it appears that tuberculosis is very rare. At Beyrout (mean temp. 69°6'), of 75 children examined by Mr. Kaye, there were only three with any sign of external scrofula, and these cases were afforded by the worst part of the town, where the atmosphere is close, damp, and tainted by decomposing animal matter, and the children were dirty; a scar on the necks of adults is seldom seen. (Phillips, p. 336.) Of 1297 patients relieved during three months at the Dispensary, 4 only are recorded as phthisis, and 110 as intermittent fever. Phthisis is stated to be a rare disease, and scrofula, hydrocephalus and tabes mesenterica are not mentioned. (Dr. Kerns; Lancet, vol. i, 1842-43, p. 869.)

Dr. Fryer, who travelled in *Persia* in the 17th century, and gave an account of the diseases which prevail, does not mention consumption or scrofula, and Chardin states that the Persians are not subject to pulmonary complaints. (Southey on Pulmonary Consumption. 1814. p. 46.)

The testimony of the French writers with respect to *Algiers* and the *Barbary coast,* is equally in favor of this comparative immunity from the disease, although this district extends beyond the line of 70°, the mean annual temperature of Tunis being 68°5. According to M. Broussais, in Algiers, where intermittents prevail, of 40,000 sick in the French army, only 62 were phthisical, or 1 in every 650 sick, and the deaths from phthisis were 1 in 102; while in the army in France, it is 1 in 5 deaths; this extraordinary disparity is referred by M. Boudet and others to the antagonistic operation of malaria.

The climate of the *western coast of Africa* is characterized by extreme humidity and sudden transitions from heat to cold, but not so great as many localities in the East Indies and other tropical countries. We have no authentic records of the prevalence of tuberculosis amongst the native inhabitants, and can only infer its infrequency from the facts relating to the troops stationed there.

At *Sierra Leone,* an essentially hot and humid climate, of 124 deaths of British Officers, not one was from pulmonary disease, and the Negro troops are not half so subject to disease of the lungs here as in the West Indies and other colonies.

Taking the torrid zone in the Western Hemisphere, *Mexico* is situated a few degrees north of the warmth equator, about 6560 feet above the level of the sea, the atmosphere being extremely rarified, the site of the city excessively damp, near a lake with marshy borders, and evaporation very rapid. According to general opinion tuberculosis is very rare, but Dr. Martinez (quoted by M. Louis) found $^1/_5$th of 40 subjects tubercular.

South of the warmth equator in this zone, the evidence is in general favourable to the infrequency of the disease. In *St. Helena* the mortality of the population from diseases of the lungs is but 3·2 per 1000 annually; (Col. Tulloch). Of 43 officers who fell sick during four years in this island, 1 only was a case of consumption. (Idem.)

There is probably no country on the earth that the temperature is more uniform than *British Guiana.* According to Dr. Hancock, tubercular consumption is unknown on the coast, and extremely rare in the mountains, although by no means infrequent in the *Llanos.* The author never met with a single case of genuine phthisis on the coast of Guiana, nor a single case of calculus generated there; facts which, if to be relied upon, are of the more importance owing to a great proportion of the inhabitants being Africans, who, when transported to any other region of the globe, have been shewn to be especially liable to tuberculosis. This statement, if correct, shews that the immunity of the population from the disease here, as in other localities, is no guarantee against its occurrence under special anti-hygienic circumstances, as, for instance, army discipline, since, from a table which will presently be given, it appears that the disease is as frequent here in the British troops, white and black, as in almost any other part of the globe.*

According to Dr. A. Smith's account of *Peru,* tuberculosis is frequent in *Lima;* but in elevated parts of the Andes it is much less so, if indeed the inhabitants do not enjoy a complete immunity. (Edin. Med. and Surg. Journal.)

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* Observations, on the Climate, Soil, &c. of British Guiana. 1835. Brit. and For. Rev., vol. i, p. 508.

The *Mauritius* presents great diversity of climate; upon the whole it is mild, rather humid, with a limited range of temperature; yet so far as an inference can be drawn from the army returns, it is by no means unfavourable to the occurrence of consumption, a greater proportion of the men being attacked annually than in the United Kingdom, the Mediterranean or America. I have no information before me of the liability of the native inhabitants to the disease in any of its forms.

Like the West Indies, this climate is most fatal to the Negro race.

The principal part of the *East Indies* is included between the isothermal lines of 75° and the warmth equator, comprising a country with a mean annual temperature, for the most part, from about 76° or 78° to 84°. In so immense an extent of territory it would be useless to attempt any general definition of climate; but it appears to possess no absolute immunity, either as respects its geographical position or the constitution of its native inhabitants, from the production of tuberculosis, as shewn by the facts related at page 490, concerning the jail at Midnapore, and as further proved by tuberculosis occurring in its most aggravated form among the sewer-bred rats of Calcutta. (Webb's Path. Indica.) Ourang-outangs, bears, and Arab horses, when imported into Calcutta, die of tubercular disease, which could not have been hereditary, nor could there have been a congenital predisposition, but they are clear instances of the disease having been acquired.

The testimony respecting India is extremely conflicting, according to Dr. Stewart, who admits that the children of Europeans are almost exempt from scrofula; the half-castes—chiefly the children of officers by native mothers—are all scrofulous, and the tuberculous constitution is the prevailing one in the native Hindoos, although the disease does not develope itself so early as in England. Dr. Jackson represents

8	out of	10	half-caste children	scrofulous.
5	„	10	Native „	„
4	„	10	English „	„
1	„	10	Mussulmen „	„

Dr. Spry also represents the whole of 75 half-castes, 300 out of 504 natives, and not one of 146 children of pure English parentage, as affected with swelled cervical glands. On the other hand, the infrequency of external scrofula in Calcutta is stated most

positively in Dr. Allen Webb's work; although it is admitted to be frequent in the lower range of the Himalaya mountains. I extract Dr. Green's testimony on this point. (Lib. cit. p. 126.)

"Taking the test which Mr. Phillips chiefly resorts to, namely, the existence in the glands of the neck of scrofulous swellings in children, or the marks of cicatrices where they have been opened by the knife or by ulceration, I can assert that I have never seen such swellings, nor ulcerations, nor have I consequently had occasion to open them, in the 300 children of all ages, and even to adult age, of which the Government Orphan School consists, and the greater part of whom are half-castes, the remainder European. In the children of La Martinière (260), all of Calcutta, of whom not more than 30 are European bred, and who are likewise under my medical care, their ages varying from 4 to 16, and also chiefly half-caste, the remainder European or Armenian, the only children among the girls having marks of scrofula belong to one family, and are European bred. Of the boys, two only present *marks.* Moreover, the Orphan School children are always examined carefully upon admission, yet in these examinations for the last four years I never saw marks of scrofula. In the Orphan Schools there are between 400 and 500 admissions to hospital, annually, yet not one entry for scrofula. How, therefore, can scrofula be so rife in Calcutta as to exist in so large a proportion as 80 per cent. in East Indian children, and 40 per cent. in English-bred children? Among the natives of India inhabiting the lower range of the Hymalayan mountains, I have certainly seen scrofulous swellings and ulcers in the neck, common; but in no other part of India do I know this disease to prevail generally; yet I have had the rare fortune of seeing nearly all of the country, having traversed it from Cape Cormorin to the Hymalaya, from the Sutledge to the Barampooter."

The profession is greatly indebted to one of the Directors of the East India Board, Lieut.-Col. W. H. Sykes, F.R.S., for some very valuable Statistical Essays on the Diseases of India, published in the *Statistical Journal,** from which I extract the following facts.

In 267,456 cases of all diseases occurring in five years at the dispensaries in *Bengal and the North-West Provinces,* there are re-

* Statistics of the Government Charitable Dispensaries of India, chiefly in Bengal and the North-Western Provinces. Statistical Journal, March 1847. Mortality and Chief Diseases of the Troops under the Madras Government. Idem. May 1851.

corded 1158 admissions for external tuberculosis or scrofula, and three deaths; or 1 in 230 cases of all diseases; and 1 in 525 of the deaths; and 187 admissions for tuberculosis pulmonalis and nine deaths, or 1 in 1430 of the cases of all diseases, and 1 death in 175 of the whole deaths.

From six out of seventeen of the dispensaries there were *no* cases of phthisis and in some others a solitary *one*, from which it would appear that tuberculosis, in this form at least, is comparatively non-existent in certain localities, although colds and catarrhs are common enough. 455 cases of scrofula are reported as cured, and the most remarkable circumstance is that 49 of the cases of tuberculosis pulmonalis are also reported as cured.

We must not infer from these statistics that in any part of India there is an absolute immunity from the disease. The results are founded too little on post mortem examinations. The tables also clearly shew that, as in our dispensaries in England, a large proportion of the results are not known; (94,618 out of the 267,456 cases). Neither can it be expected, with the Native Assistant Surgeons, by whom the reports are made up, that the diagnosis is so generally accurate as in this country; although subject to correction by the European Superintendent Surgeons. It may ultimately appear that tuberculosis, as a disease of the blood, although comparatively less frequent in this climate than our own, is nevertheless more frequent than at present appears. There is a large proportion of cases recorded under the head of "asthma," and as many as 20,153 cases of "ulcers," including 20 deaths. A portion of these may be cases of tuberculosis. The frequency of tubercular disease of the bones has also been previously mentioned (p. 325). It also appears that among the children of the native Hindoos, in Upper Hindostan, especially those who are nurtured in the innermost recesses of cooped-up houses, a disease called *mithooa* is very fatal. The native surgeon reports (Stat. Journ., March 1847, p. 13), that it resembles the *tabes mesenterica* of European authors, being characterized by the same wasting of the body, tumefaction of the abdomen, slow fever, disordered bowels and death; but the identity of the two diseases has not been verified by *post mortem* examination.

In the *Madras* Presidency, Dr. Balfour's Statistical Report* shews the great infrequency of consumption in the natives serving

* On the Sickness and Mortality of the Troops serving in the Madras Presidency. 1847.

as British troops. At the stations on the Sea Coast, the ratio of fatal cases was not more than ·4 per 1000; the same at the stations on the Plains; and on the Table Lands ·3 per 1000. During ten years, throughout the Presidency, the number of native troops invalided for "thoracic diseases" was only ·6 per 1000 annually. In the British army all over the East Indies the occurrence of tuberculosis in any of its forms is extremely rare, not much more than 1 case of consumption being reported per 1000 men. These facts will be exhibited in a tabular form, under the next head.

In the island of *Ceylon,* rather south than north of the isothermal equator, but so close that it is better considered in connection with India, where, owing to the proximity of the equator, the diversity of seasons is scarcely known, one of the mildest and most equable climates, upon the whole moist, but exceedingly variable in this respect, and a cooler climate than India, the number of cases of consumption in the army was nearly as great as in Canada, the symptoms differing in no respect, and although the progress of the disease was slower, its fatality and the post mortem appearances were the same as usually observed in Europe. The fact which bears upon the present subject, however, is that the native regiments were comparatively little affected; the mortality occurring especially in the Negro and Malay regiments, and to a certain extent among the Sepoys.

The *Tenasserim provinces* are characterized by a very high temperature and extreme moisture, with heavy rains and inundations, and a more variable climate than Ceylon. During four years, five times as much rain fell as in Britain, and twice as much as in most other tropical climates. If moisture and variability conduced to the disease, here it ought to be met with, but Colonel Tullock remarks, that with respect to hæmoptysis and consumption, this station seems to warrant the pleasing conviction that some parts of the world are comparatively exempt from diseases which elsewhere prove such a source of mortality to our race; here, as almost uniformly in India, the proportion of troops attacked with consumption did not materially exceed 1 per 1000, annually, although when the disease occurred, it was almost uniformly fatal, and advanced to that termination more rapidly than in temperate climates. February, March and April are generally deemed most inimical. Consumption in the black troops is not mentioned.

If the preceding facts are favourable to the opinion that the meteorological torrid zone, north and south, is in the main less subject to tuberculosis than climates of a more temperate quality as respects the mean heat, this is not so clear in the western portion of this zone, north of the warmth equator.

The mean temperature of the *West Indies* is 79° or 80°, its mean daily range about 6°, and its extreme annual range 20°; the atmospheric pressure is very equable, the climate is upon the whole damp, but extremely variable in this respect, not only in different islands, but at different elevations and different seasons, and they are subject to the easterly or trade winds during nine months of the year. The statements respecting the prevalence of tuberculosis pulmonalis in these islands differ greatly, some writers affirming that it is very frequent in the natives, more so in the Europeans, and most of all in the African population. Scrofula is said to be rare. (Clark, l. c. p. 327.) Dr. Musgrave, Dr. Davy, and Dr. Hunter represent it as very rare indeed among the indigenous inhabitants; Dr. Chisholm states that it is very frequent. (Clark, p. 317.) Col. Tulloch represents 5 per 1000 of the population of Jamaica as dying annually of disease of the lungs. According to M. Rufz, scrofula is very rare in Martinique; from 1834 to 1839 he saw but one or two cases of white swelling, no case of Pott's disease, and but very few of glandular disease, but consumption is as frequent as in the Paris hospitals. Whatever may be the facts relating to the prevalence of tuberculosis in this part of the world, which can only be determined by more extended statistical data than we now possess, it is remarkable, as will be shewn under the head of "The Effects of Change of Climate," that British Troops are to a great extent more liable to the disease when stationed in these islands than in their own country, whereas, as already stated, they are much less so when stationed in the East Indies.

(*c*) *The temperate zones.* As remarked of the geographical temperate zone, in this zone meteorologically considered, the greatest differences exist. Here we have the highest grades of civilization, the most complicated relations of society, the greatest differences of climate, and the greatest amount of tuberculosis in the native inhabitants. The range of mean annual temperature is from 30° to 70°. We have already shewn that in most of the highest latitudes comprised in this range, as also in the lowest, the disease is comparatively rare. In the central regions north of the warmth

equator, including England, France, Germany, Spain, Portugal, Italy, the northern shores and Archipelago of the Mediterranean, and the sections of India, China, and North America, included in this range, it is the most universal cause of the deterioration of the human species and of premature decay and death, although varying greatly in degree in different countries and localities.

In the more *northerly part* of this region, we have still reason to think that the disease is rather less frequent than elsewhere. In *Sweden*, the most populous districts of which are situated between the isothermal lines of 40° and 45°, according to some authorities the ratio of deaths from phthisis is only 1 in 15·8 deaths. (Sweet, l. c., p. 233.) According to Colonel Tulloch, there were in one year, 5·6 deaths from diseases of the lungs per 1000 of the whole population. From observations made at the military hospital at *Stockholm*, the mortality from phthisis among the troops, according to Dr. Gellerstedt, is 8 per 1000, and upon an average, 6 more were dismissed for pulmonary complaints at their own request. The author refers this to the life of a soldier being favourable to the production of the disease, and he considers consumption is a disease on the increase in Sweden.* In the *Feroe islands* phthisis is said to be as rare as in Lapland. In *Denmark* consumption is very rare; (Lord Molesworth). According to Fenger's account of the diseases in *Copenhagen*, the mortality from all diseases of the chest, between the ages of 15 and 30, is lower than that arising from phthisis alone in this country.†

Canada is an extremely cold climate, distinguished by the severity of its winters and sudden alterations of temperature. At Quebec the thermometer has been known to fall 70° in twelve hours. Its atmosphere is clear and dry. We have the most favourable accounts from Mr. Orten (Edin. Med. and Sur. Journ.) and other writers, in relation both to scrofula and phthisis, which appear to be comparatively very rare indeed.

Between the isothermal lines, north of the warmth equator, of 46° *and* 65° *or* 70°, tuberculosis, although varying in frequency in different countries and localities, is uniformly one of the most general and most fatal diseases. The best criterion we have of its relative frequency is the relative mortality from its most fatal form, and Dr. Caspar, of Berlin, has constructed the following Table of

* Brit. and For. Review, April 1847, p. 437.
† Idem, July 1842, p. 117.

this, from the records of different countries, during periods of from 20 to 30 years. All the places contained in this table come within the present meteorological division, and it appears that, from about a fourth to a sixth of those who die of disease are destroyed by tuberculosis pulmonalis; there were—

In Berlin,	during	10	years,	1	death	from	phthisis	in 5·7 deaths.
„ Paris	„	4	„	1	„	„	5·5	„
„ London	„	2	„	1	„	„	6·2	„
„ Hamburg	„	3	„	1	„	„	4·6	„
„ Stuttgardt	„	10	„	1	„	„	4·7	„
„ New York	„	11	„	1	„	„	5·	„
„ Philadelphia	„	7	„	1	„	„	7·7	„
„ Baltimore	„	8	„	1	„	„	6·7	„
„ Boston	„	7	„	1	„	„	5·9	„

That is to say, in upwards of 60,000 deaths in different populations, upon an average, about *one death in six* is produced by this disease.*

The comparative frequency of the external forms of the disease, having a fatal tendency, is to a certain extent represented by the following statistics, collected by Mr. Phillips. The proportion of deaths from scrofula were found to be, in :—

Paris	(series of years)	1 in 3221 of the population	
Geneva	(idem)	1 in 2790	„
„	(1842)	1 in 3867	„
London	(4 years)	1 in 9000	„
„	(1840)	1 in 7500	„
New York	(1840)	1 in 1241	„
Philadelphia	(1840)	1 in 453	„

The rejection of recruits for scrofula were—in France 2 per cent; in the department *du Nord* 4·6 per cent.; in the Eastern Pyrenees 1 per cent.; and in our own army 1 in 119.

The marks of scrofula adopted as diagnostic by Mr. Phillips, were presented by children in different countries and localities, according to the following ratios :—

Orphan Asylum, Lisbon	35	per cent.
„ Amsterdam	42	„
„ Munich	66?	„
„ Vienna	11	„
„ Berlin	53	„
St. Petersburg	41	„
Foundling Hospital, Moscow	9?	„
House of Industry, Boston	70	„
School Children, Philadelphia	·04	per cent.?
England and Wales—many districts	24· 5	„
Limerick	54·	„

* The British and Foreign Review, July, 1847.

Mr. Phillips accounts for the low return from Moscow by a difference in the mode of making the returns.

The frequency of the disease in *Great Britain,* especially, has been treated of in a former part of the present chapter; (p. 369).

The frequency of *tuberculosis* for all England, in the year 1847, is represented by 1 to 251·9 of the whole population, and by 1 in 6·2 of the deaths; (Table XIX, p. 408).

The following valuable Table of the frequency of death, both from consumption and scrofula, under different circumstances of locality in this climate, has also been drawn up by Mr. Phillips. (lib. cit., p. 361.)

TABLE XXVI.

		Deaths from Consumption.	Deaths from Scrofula.
Sea-side Towns	1,481,115	1 in 301	1 in 12,030
Inland Towns	1,653,922	1 in 266	1 in 13,178
Manufacturing Towns . .	2,043,038	1 in 219	1 in 20,430
Non-Factory Towns . . .	2,870,416	1 in 256	1 in 19,526
Linen and Cotton Towns . .	945,159	1 in 209	1 in 24,549
Woollen Towns	715,097	1 in 252	1 in 17,425
Eastern Counties . . .	1,041,000	1 in 258	1 in 8,395

France, Belgium and *Holland* are proverbially subject both to scrofula and phthisis. In *Holland* external tuberculosis is considered to be decidedly on the increase. As suggested by Mr. Phillips of scrofula, the statistics before us distinctly prove that neither scrofula nor phthisis is eminently an English disease; in fact, at the present time, they are greatly more frequent in many localities, both in America and in continental Europe.

M. Cunier directed his attention especially to the question of the influence of humidity over the production of scrofula, in localities in the province of *Brabant,* in which scrofula so abounds that it may be said to be *endemic,* and after the most minute investigation he came to the conclusion that its great prevalence was attributable neither to the moisture nor to any other property of the air or of the locality, but to the life of privation from good air and food, and frequently of intemperance and irregularity led by the inhabitants. (l. c., p. 21.)

As respects France, by one account, in the *Paris* hospitals there is 1 death from phthisis to 3·25 deaths; by another, $^2/_3$ of the autopsies in the Hospital des Enfans Trouvées and in La Charité are tuberculous. We have authentic records of both scrofula and

phthisis being excessively frequent in almost all the large towns in France; at Marseilles, the deaths from phthisis are 1 in 4; at Montpellier, there is no lack of it (Lugol). At Orleans and Rheims the ravages of scrofula are very great.

M. Benoiston de Châteauneuf records that:—

Of 3742 deceased soldiers, born in the			North of France,	296	were phthisical.
„ 7165	„	„	Central France,	526	„
„ 4375	„	„	Meridional France,	361	„

The maximum of frequency being for individuals born in Meridonial France.

In most parts of *Germany* the disease, both in its external and internal forms, appears to be quite as frequent as in England and France. At *Munich,* in the Orphan Asylum, two-thirds were reported to Mr. Phillips as scrofulous; three-fourths of the children are said at one time to have died before ten years of age; since boarding in the country has been extensively adopted, with an improved diet, the proportionate number of deaths has considerably diminished. At *Berlin,* almost all the children at the time of their reception into the Orphan Asylum are reported as "more or less" affected, and this awful frequency is attributed by the reporter mainly to the use of food (particularly starch diet) adapted for the formation of tuberculous matter, arrested cutaneous functions, the continued breathing of an impure air, and hereditary transmission.

Taking the more *southern part* of this region, the countries to which tuberculous invalids are expatriated in search of health, we find the disease nearly if not quite as frequent as in the more northern. In the Mediterranean Archipelago phthisis makes great ravages. (Andral.) In *Malta,* 5⅛ per 1000 of the whole population die annually of diseases of the lungs. (Colonel Tulloch.) Of 51 deaths out of 813 patients at the Royal Naval Hospital, 17, or one-third, were from phthisis. (Spencer Wells.) In *Spain* scrofula is endemic and phthisis very frequent. (Lugol.) Among the civil inhabitants of *Gibraltar* it is as frequent as among the military. (Col. Tulloch.) At *Madrid* both are extremely frequent. In *Greece* and *Turkey* phthisis is "very common." Scrofula appears to be remarkably frequent in *Greece.* At a school at *Athens* of 322 children examined, 111 were more or less affected, seven of whom had scrofulous joints; the more remarkable since the children had a spacious play-ground and airy apartments. (Mr. Kaye's Report, Phillips on Scrofula, p. 337.) In *Italy* it is as com-

mon as in France (Andral); in Naples 1 death in 8 is produced by phthisis; Nice has a deeply scrofulous population (Lugol), and phthisis is very common (Dr. Wells). According to Dr. Burgess, in his work on climate recently published, there is no part of France where phthisis is so prevalent amongst the native population as in Montpellier and Marseilles; in the latter, especially, its ravages among the youth of both sexes are very great. In Italy Dr. Burgess confirms its prevalency; in Venice and Geneva it is among the most frequent diseases; according to Dr. Merryon, at Nice "more natives die of consumption than in any town in England of the same amount of population," and the bills of mortality give 1 in 7 of the deaths from phthisis.

The following has been given as the ratio of deaths from tuberculosis pulmonalis, to the whole deaths in the civil and military hospitals in Italy and France.

Leghorn	.	Civil and Military . . .	1 in 10·75
Florence	.	Civil	1 in 11· 5
Rome	.	„	1 in 3· 4
Naples	.	Average of Three Hospitals .	1 in 2·33
„	.	Military	1 in 3·85
Paris	.	Civil	1 in 3·25
„	.	Military	1 in 12· 2*

From a Statistical Essay of Dr. Marc D'Espine, the *City and Canton of Geneva*, of the mean annual temperature 49° 6', contained in 1838—28,003 and 30,663, = 58,666 inhabitants. The deaths were 1405, including 82 still-born children—of these there occurred:—

From Scrofula		21
General Scrofula	14	
Caries of the Vertebræ . . .	5	
Caries of the Joints and Pelvis . .	2	
From Tubercular Diseases		188
Pulmonary Consumption . . .	155	
Mesenteric Tubercles . . .	14	
Chronic Tubercular enteritis . .	19	

This gives 1 in 6·6 deaths from all causes. The average age of those who died of consumption was 29 years; mean age at death from scrofula was 19 years $^{3}/_{10}$.

Couture and Lombard found, on the dissection of 214 children, mostly under seven years of age, 102 affected with tubercular deposits.†

* Bullet. de l'Acad., Avril, 1839.

† Edin. Med. and Surg. Journal, vol. liv, p. 166.

Dr. Rozas has furnished Mr. Phillips with an interesting account of the frequency of scrofula at *Lisbon*. In the asylum there, of 500 boys, 300 were "decidedly scrofulous," but the disease is described as milder than in this country and yielding more quickly to treatment. Of 300 girls a much smaller proportion was affected; the latter occupy the upper part of the establishment, "which enjoys freer ventilation, and a full northern aspect, and gardens at the back," while the boys occupy the lower part. (lib. cit., p. 322.)

Passing now to a consideration of the Island of *Madeira*, which is a mild and equable climate, the mean annual temperature of Funchal being 64°, and remarkably equable, not only throughout the year, but during the day and night, and also somewhat dryer than our own climate, but moister than that of Egypt or Australia; great discrepancies exist in the statements of observers as to the absolute frequency of tuberculosis; some asserting that it is very frequent among the natives and others denying it. Sir J. Clark, relying on the evidence of Dr. Renton (Edin. Med. and Surg. Journal, 1817) and Dr. Heineker, takes the favourable view. Mr. Renton reports that in a school of 405 children, of from five to fifteen years of age, there were 53 with cervical glands enlarged so as to be sensible to the touch, three in which there was tenderness on pressure, and four cicatrices; but his own observations, as well as those of the Portuguese physicians, lead to the conclusion that this form of disease is comparatively rare. Dr. Gourlay, (On the Climate of Maderia) Dr. Mason, and more recently Dr. Burgess, regard both consumption and scrofula as frequent. That there is no special immunity from the disease here, either among natives or aliens, is perfectly clear. Dr. Gourlay states that, "no malady is more frequent here than phthisis." Dr. Renton admits that it is more frequent than might *à priori* have been expected, but he directs attention to the fact, that the lower classes are remarkably exposed to the ordinary causes of the disease, their food consisting of crude vegetables and hard salted fish, they are badly clothed, their habitations are low miserable huts, and their beds consist of pellets of straw, raised a foot or two only from the ground, which is damp during nine months of the year; but he considers the disease produced most frequently similar to phthisis, although it is further admitted that "many of the children die with a tumid abdomen, emaciated extremities, rickety or scrofulous." (Clark on Climate, p. 279.)

In most of the countries in this region there are no doubt localities in which this disease is less frequent than usual. In France, at Boves and Rouen, scrofula is said to be rare, and in Normandy and Brittany less frequent than in Champagne; Sologne is said to be quite free from scrofula, phthisis and tabes mesenterica. In certain localities in Scotland, as particular sea-coast towns, both scrofula and consumption are said to be rare. In Sardinia, Piedmont and Tuscany, phthisis is said to be very rare (Dr. Trompes, Bull. del. Sc. Med. 1844); also in localities in the Alps (Laennec). There are many localities also where febrile diseases, from malaria, prevail to a great extent, which are said to enjoy an immunity from tuberculosis.

From an essay by A. Salvagnoli-Marchetti, medical inspector of the province of Grosseto, we learn that in this province, in the *Tuscan Maremma,* situate on the shore of the Mediterranean, and containing 73,966 inhabitants, a most sickly country, owing to the prevalence of malaria, that of 35,609 cases of illness occurring in a given time, there were only 5 per cent. of chronic diseases of the lungs. In 81,731 sick during 3 years, there were only 100 cases of phthisis, or 1 phthisical patient in 817 cases. Scrofula is also very rare, but of those who became phthisical three-fourths have been previously scrofulous. The country varies greatly in point of elevation, from the level of the sea to one mountain which is 5298 feet high; the climate varies accordingly, but in the plains, where the greatest sickness prevails, it is essentially warm and moist. Owing to the infrequency of post mortem examinations in this case, it remains uncertain what proportion of those who die of fever may be affected with tubercle; and the mean duration of life being only 22·50 years, it is possible that a greater proportion, if they had not been cut off by fever, would have died of tuberculosis.*

In the *United States,* in 1836, Dr. A. Brigham gave the proportion of deaths by consumption to the whole of the deaths.

Portsmouth, N.H. .	1 in 5·39	Philadelphia . .	1 in 7·17
Boston . . .	1 in 5·79	Baltimore . .	1 in 6·18
New York . .	1 in 5·89	Washington . .	1 in 8·51
Charleston, S. C. . . .	1 in 7·08		

The following is the proportion of deaths to the population, and

* British and Foreign Review, Jan. 1846, p. 205.

to the whole of the deaths, in four of the principal cities, as lately recorded by Dr. J. A. Sweet.*

	To the Population.	To the Mortality.	Period.
Boston	1 in 236	1 in 6·6	5 years
New York	1 in 267	1 in 7·2	4 „
Baltimore	1 in 290	1 in 5·4	10 „
Charleston	1 in 426	1 in 6·9	5 „

According to this, the relative mortality has decreased in Boston and New York and increased in Baltimore and Charleston; but whether owing to an increase or decrease of consumption or of other fatal diseases does not appear.

In the *south temperate zone*, between the isothermal lines of 40° and 70° comprising the southern part of South America, the Cape of Good Hope, with a portion of South Africa, nearly the southern half of Australia, Van Dieman's Land, and New Zealand, all the accounts lead to the conclusion that tuberculosis is much less frequent than in countries situate in the corresponding meteorological division north of the warmth equator, although the facts before us indicate very clearly that the disease may be produced in any locality in this part of the globe, by the operation of its ordinary inducing causes.

At the *Cape of Good Hope*, the atmosphere is temperate, but extremely variable, and it is also very variable as to dryness and moisture, but its mean dryness is probably two thirds greater than the atmosphere of London; the mortality from phthisis is below that of most European countries. In the eastern frontier district the temperature is much higher and more variable, and the air generally much drier than in the Cape district; it is also still more healthy, and consumption is still less frequent.

The climate of *New South Wales* is warm and dry, but liable to sudden variations, the mean annual temperature of Port Jackson being 62°·89; it is liable to dry, sultry winds and great droughts. South Australia is also characterized by extreme changes of temperature, generally three times a day. Western Australia is much the same, but more moist and less liable to droughts. Tuberculosis in any of its forms is generally regarded as a rare disease in Australia. Of 560 cases of all diseases treated at the *Sydney*

* On the Diseases of the Chest, 1852, p. 240.

Dispensary, in 1836, 9 only are designated consumption, and 7 scrofula. (Brit. and For. Rev. p. 261.)

Van Dieman's Land is a temperate, but an exceedingly variable climate; both external glandular and internal tuberculosis are infrequent. According to the return of diseases treated at the Colonial Hospital, Hobart Town, furnished by Mr. Scott, there was only 1 scrofulous case in 322 of all diseases, and of both scrofula and phthisis not more than 1 in 101. There is reason to think that the natives in their aboriginal state are little prone to the disease.

The following table will serve to compare the relative frequency of phthisis in Van Dieman's Land with certain parts of the United Kingdom and other countries.

TABLE XXVII.

*Comparative ratios of cases of Phthisis to the number of cases of all diseases in various localities.**

Dispensaries, &c.	Total Cases of Disease.	Phthisis.	Ratio of Phthisis.
Hobert Town	30,102	104	1 in 239·4
Ionian Isles	84,438	339	1 in 249
Malta	46,639	235	1 in 198·8
Cape of Good Hope	25,506	135	1 in 189
Gibraltar	58,227	394	1 in 147·7
East Indies	267,456	187	1 in 1430
Birmingham	18,663	295	1 in 63·9
Plymouth	5,648	176	1 in 32
Land's End	8,827	297	1 in 29·7
Land's End and Worcester	18,032	713	1 in 25.2
Worcester	9,255	416	1 in 22·2

New Zealand is a mild, soft and equable climate, being free from all extremes of heat and cold, the range of its temperature throughout the year and during the day very inconsiderable; the fall of rain moderate, and distributed very equably throughout the year, characterized by a remarkable liability to winds producing a purity of the atmosphere, which gives elasticity to the physical powers and to the mind, and "to which may be owing in a great measure the healthiness of the country." (Clark on Climate, p. 357.)

* Brit. and For. Review, July 1838, Clark on Climate, and Col. Sykes's Paper.

By some writers, tuberculosis in the scrofulous and tubercular forms is said to be prevalent among the natives, but I am inclined to think this applies to their liability as altered since the islands have been taken possession of by the whites, and not originally. At *Aukland*, the number of admissions of the military into hospitals for chest affections is one-third less than in Great Britain, and the common rumour that consumption is peculiarly fatal and prevalent among Europeans is probably incorrect.*

2. *Change of Climate.*

There is very clear evidence that tuberculosis frequently results from change of climate. Animals brought both from warm and cold climates to the menageries and zoological gardens of London, Paris, and Calcutta, die of tuberculosis pulmonalis. The negroes transported from the interior of Africa to different climates also die of this disease; carried to the island of Ceylon they are "cut down by tuberculization;" in Egypt they also frequently die of it, and in the West Indies more frequently. The natives of India, who serve as troops in Ceylon and in China, are also much more liable to the disease than in their native climate, and the Laplanders, who are remarkably exempt both from phthisis and scrofula, are said to become liable to both on transportation to Denmark.

We have before us what may be deemed an experiment on a large scale on the effects of change of climate, in the case of troops sent to foreign stations. The following table, which shews the prevalence of the disease, at home and abroad, in large bodies of men, during a definite period of life, subject as nearly as possible to the same discipline and to similar habits, embraces facts of the highest importance in the elucidation of this question. It has already been pointed out that the customs of a soldier's life, and barrack discipline, are favorable to the production of the disease, so that the results must not be regarded altogether as the effects of change of climate. They rather indicate the influence of climate in aggravating or modifying the action of anti-hygienic causes and they are of the greater weight, inasmuch as the influence of the change of climate is continued for a long period, and the numbers represent the average results of a long series of years.

* Dr. A. Thomson, Statistical Journal, Sept. 1851.

TABLE XXVIII.

The extent to which British Troops are invalided for Scrofula at different Military Stations. (Phillips, l. c.) *The annual proportions of deaths from all diseases and from Diseases of the Lungs, "nearly four-fifths of the latter being from Consumption."* (Col. Tulloch.) *Also, the proportion per* 1000 *attacked annually, the proportion invalided, and the proportion of deaths per* 1000 *from Consumption at various stations. Compiled from Col. Tulloch's War Office Reports.*

	Deaths from Scrofula.	Deaths from Diseases of the Lungs per 1000.	Deaths from all causes per 1000.	Deaths from Consumption per 1000.	Attacked Annually with Consumption per 1000.	Invalided for Diseases of the Lungs.
The North Temperate Zone (30° to 70°) mean t.						
Canada	1 in 600	6·7	16·1	4·5	6·5	1 in 4
Nova Scotia and New Brunswick	1 in 928	7·1	14·7	5·4	7·	1 in 4
Great Britain (Dragoon Guards & Dragoons)	...	7·7	15·3	...		
(Foot Guards)	...	14·1	21·6	...	5·6	
(Household Cavalry)	...	8·1	14·5	...		
(Depôts of West India Corps)	...	9·6	18 5	...		
(Cavalry)	1 in 433					
(Infantry)	1 in 17,269					
Ionian Isles	1 in 378	4·8	25·2	3·5	5·3	1 in 6
Gibraltar ... ... (Whites)	1 in 486	5·3	21·4	4·3	6·5	1 in 3¾
(Blacks)	...	33·5				
Malta	1 in 592	6·	16·3	4·2	6·7	1 in 3¾
Bermuda ... ... (Whites)	1 in 1172	8·7	28·8	7·6	8·8	
(Blacks)	...	9·7				
Bahama Isles ... ... (Whites)	1 in 535	3·	107·			
(Blacks)	1 in 591	9·7	41·			
The North Torrid Zone (70° to 88°) mean temp.						
Jamaica ... ... (Whites)	1 in 859	7·5	121·3	7·	13·	1 in 6
(Blacks)	1 in 818	10·3	30·			
Windward and Leeward Command (Whites)	1 in 1141	10·4	78·5	9·1	12·	1 in 7½
(Black Troops and Pioneers)	1 in 1137	16·5	40·			
Barbadoes ... ... (Whites)	1 in 11,968	15·8	58·5			
(Blacks)	1 in 8921	18·7	46·			
Tobago ... . (Whites)	...	11·	152·8			
(Blacks)	...	12·	34·2			
Trinidad ... ... (Whites)	...	11·5	106·3			
(Blacks)	...	16·4	39·7			
Honduras ... ... (Whites)	1 in 320	1·	33·			
(Blacks)	...	8·1	30·			
Madras ... ... (Whites)	1 in 576	...				
(Natives)	...	1·				
Tenasserim ... ... (Whites)	1 in 452	2·	44·7			
Burmese Empire ... ... (Whites)	...	2·7	446.	...	2·5	
Sierra Leone ... ... (Whites)	1 in 921	4·9	483·	3·	7.	
(Blacks)	1 in 583	6·3	30·1	...	4·	
Cape Coast Command ... ... (Whites)	...	1·6	668·3			
(Black Troops, Natives)	...	...	20· (?)			
Ceylon ... ... (Whites)	1 in 895	4·1	69·8	3·4	5·	
(Blacks)	1 in 724					
STATIONS:—						
Trimcomalee ... ... (Whites)	...	4·6	91·3			
Kandy ... ... (Whites)	...	5·	60·7			
Colombo ... ... (Whites)	...	5·3	51·9			
Galle ... ... (Whites)	...	2·6	23·			
REGIMENTS:—						
Malays ... ... (chiefly)	...	3·6	24·8			
Pioneers .. (all Natives of India)	...	2·5	45·			
Gun Lascars ... (Natives of India)	...	1·9	12·4			
Armed Lascoreyns (chiefly Natives of Ceylon)	...	1·6	23·3			
Negro Troops	...	6·1	52·			
The South Torrid Zone (88° to 70°) mean temp.						
British Guiana ... ... (Whites)	...	6·4	84·			
(Blacks)	...	17·9	40·6			
St. Helena ... ... (Whites)	1 in 246	3·4	25·4			
Mauritius ... ... (Whites)	1 in 691	5·6	27·4	4·3	7·7	
(Black Pioneers)	1 in 1395	12·9	37·2			
The South Temperate Zone (70° to 30°) mean t.						
Cape of Good Hope—						
Cape District ... ... (Whites)	1 in 295	3·9	13·7	2·8	5·5	1 in 9
(Blacks)	1 in 413					
Eastern Frontier ... ... (Whites)	1 in 331	2·4	9·8	..	3·3	1 in 9
(Blacks)	1 in 413	3·9	10·9	...	3·3	
Western Coast of Africa ... (Blacks)	...	6·3	144·5	1·7		
New Zealand	...	5·7	10·			

The following is extracted from Dr. Balfour's Statistical Report, before referred to :—

TABLE XXIX.

The admission into Hospital, and Deaths from Consumption, of the Troops at the principal Colonies, from 1830 *to* 1836 *inclusive, compared with those among the Troops in the United Kingdom, and especially in the Madras Presidency.*

	Strength.	Admitted.	Died.	Ratio per 1000. Admitted.	Died.
United Kingdom	44,611	286	236	6	5·3
Gibraltar	22,868	187	139	8	6·1
Malta	15,031	101	54	7	3·6
Ionian Islands	24,401	129	79	5	3·2
Bermuda	5,894	47	38	8	6·4
Nova Scotia and New Brunswick	16,082	109	89	7	5·5
Canada	19,989	151	109	8	5·4
Cape of Good Hope	6,957	34	17	5	2·4
Ditto, Frontiers	2,883	9	6	3	2·1
Ditto, Hottentots	4,136	14	10	3	2·4
W. and L. Command	33,839	389	218	11	6·4
Ditto, Black troops	9,442	65	49	7	5·2
Jamaica	18,817	253	139	13	7·4
Ditto, Black troops	2,008	7	6	3½	3·
Mauritius	13,162	96	51	7	3·9
Ceylon	14,590	78	51	5	3·5
MADRAS—					
Europeans — Sea Coast	14,992	43	19	3	1·3
Europeans — Plains	4,502	2	1	½	·2
Europeans — Table Lands	22,583	50	16	2	·7
Natives — Sea Coast	77,504	74	29	1	·4
Natives — Plains	176,877	48	28	⅔	·4
Natives — Table Lands	23,929	57	33	½	·3

Perhaps the most decided case of an amelioration of the tendency to death from tuberculosis, and with it the tendency to the disease, is afforded by the case of Europeans resident in India. Proofs of this are not only afforded by the foregoing tables but are derived from other sources. From Mr. Martin, after a very long residence there, we learn that the civil as well as military European residents are almost exempt from scrofula, and so are their children; and this exemption is equally true of parents and their offspring in Bengal, whose families in England are notorious sufferers. During an extensive observation of 26 years, in Calcutta, Mr. Martin did not remember three instances of scrofula declaring itself, though there were numberless persons in whom the disease remained latent. From 1830 to 1836 inclusive, in 105,919 British troops in the East Indies, 598 only were admitted into hospital for tuberculous diseases, and 172 only died, or 5·7 admissions and 1·6 deaths per 1000, as indicated by the

table; whereas in 44,611 British soldiers serving in the United Kingdom, 483 admissions and 253 deaths, or 10·8 admissions, and 5·7 deaths per 1000 occurred. The climate is represented as pre-eminently beneficial in scrofulous disease. Mr. Martin has known instances without number of individuals labouring under tuberculosis (tubercular cachexy), but enjoying good health in Bengal, and surviving their brothers and sisters at home; but where individuals go to India with suppurating tubercles, or even in the stage immediately approaching to it, the disease is only precipitated. (Phillips, p. 341.)

From Colonel Sykes's paper on the statistics of the Madras army, some inference may be drawn of the comparative infrequency of tuberculosis, both in the native inhabitants and in those who migrate to the east torrid zone, from 22° 50′ to 8° 5′ north latitude. The tables embrace the diseases and mortality of 59,218 Europeans, and 363,726 natives, during five years, from 1842 to 1846 inclusive; and of 11,303 European and 67,015 native troops during the year 1847, in fourteen stations in India and China. During the five years the ratio of deaths from *thoracic diseases* at the different stations was as follows:—

TABLE XXX.

Command or Station.	Ratio of deaths from thoracic diseases, per 1000 strength.		Ratio of deaths from thoracic diseases to the deaths from all diseases.	
	Europeans.	Natives.	Europeans.	Natives.
Presidency Division	1·89	0·17	1 in 13·5	1 in 125·
Centre Division	2·16	1·13	1 in 19·5	1 in 19·7
Southern „	0·67	0·59	1 in 55·	1 in 50·6
Northern „	7·52	0·84	1 in 8	1 in 25·
Mysore „	1·40	0·56	1 in 16·7	1 in 46·
Malabar and Canara	2·06	0·52	1 in 15·	1 in 15·3
Ceded Districts	1·12	0·41	1 in 53	1 in 59·8
Hyderabad Subsidiary Force	1·32	0·47	1 in 42·7	1 in 49·9
Nagpore	0·55	0·39	1 in 83	1 in 39
Tenasserim provinces	3·03	0·80	1 in 9	1 in 23·4
Aden	4·48	0·71	1 in 12·8	1 in 30
China	..	1·93	..	1 in 46·2
Sauger	..	0·43	..	1 in 19
Southern Mahratta Country	..	3·45	..	1 in 54·2

The average number of deaths from all diseases during the five years, among Europeans, was 38·56 per 1000, and among the native troops 20·76 per 1000.

In 1847 the average of deaths from "thoracic diseases," at the whole of these stations was 2·39 per 1000 Europeans, and 0·59 per

1000 natives, and the deaths from thoracic diseases to the deaths from all causes was—in Europeans as 1 to 12, and in natives as 1 to 21·4.

According to Dr. Balfour's table, from the year 1830 to 1836, the ratio of mortality among Europeans from consumption was, at the Sea coast stations 1·3 per 1000; on the Plains, between the Sea coast and the mountain ranges, ·2 per 1000; and on the Table Lands ·7 per 1000. The greater mortality on the Sea coast is accounted for by the number of deaths at Madras being nearly double that of other stations, owing probably to the number of invalids who assemble there for embarkation to England, and to the irregularities of the troops when they first arrive.

It is important to remark, that the low ratio of mortality from tuberculosis among the troops in India, Native or European, is not referrible to those attacked with the disease being sent home as invalids. (Col. Tulloch, Dr. Balfour.)

The statistics before us exhibit some most interesting particulars, relating to the occurrence of tuberculosis in the different *races of mankind*, in other than their native climates; but with respect to their liability to this disease in their own country there are various opinions extant, and conflicting statements. The natives of the East Indies are manifestly but little liable to the disease in their own climate. As respects the natives of Africa we know little. In Clarence Town, in the Island of Fernando Po, of 52 deaths during the year 1841, occurring among the African inhabitants, the causes of which are recorded by Dr. M'William, neither scrofula nor consumption are mentioned;* from which it may be inferred that it is not peculiar to Africans. Many recent authors have affirmed that the Americans are very liable to it, but they have manifestly drawn their conclusions from this unfortunate race, as they now find them, and since the alteration of their habits by association with their more civilized brethren; whereas, Dr. Rush, who speaks explicitly of their aboriginal condition, states that consumption was unknown among them. Of the aborigines of New Zealand and Van Dieman's Land the same uncertainty appears to exist.

There is no case in which the injurious effect of change of climate appears to be more conclusive than in the *negro* race, but in reasoning upon the facts we must not forget that we are totally

* Medical History of the Expedition to the Niger. 1843. p. 113.

ignorant of their degree of liability to the disease in their native climate.

This great susceptibility, when inhabiting climates unnatural to them, has been remarked by all writers. In almost all cases where placed under similar circumstances with the whites, as exemplified in negro troops serving with white troops in the West Indies, they more frequently become tuberculous. The case is the same in civil life. In the city and county of New York, in the year 1842, the mortality of the African and other dark races, above ten years of age, from this disease, was 9·329, the total mortality being 27·225 per thousand; the mortality of the whites from 10 to 70 years of age was 4·235 per 1000, the total mortality being 14·505 per 1000. This difference in the relative mortality of the two races has been verified in series of years, and it becomes exaggerated in the state of imprisonment; the mortality of the white races is raised from 13 or 15 to 20 per 1000, and that of the coloured races, which ranges from 23 to 27 per 1000 out of prison, is raised to 70 per 1000 in some prisons. (Dr. Baly, lib. cit.)

Mr. Pearson, who superintended the establishment for African boys brought over for education by the Sierra Leone Company, states, that they all died of consumption (Heming on Scrofula, p. 29). It is remarkable, he says, that boys brought from tropical climates, from the age of 8 to 12, almost uniformly become scrofulous; they bear the first winter tolerably well, but droop during the second, and the third generally proves fatal to them; sometimes the consumption was preceded by swelling and suppuration of the glands, enlargement of the bones, &c.; but in the female, phthisis was often the primary complaint. These are instances of the effects of change from a warmer to a colder climate, but the result is the same, when the African race is transported to the West Indies, a climate as warm and even warmer than their own. So also in France, the mortality from this disease is very great indeed. The fact is important in reference to the effect of climate in these cases, that black troops serving in Sierra Leone are less liable to consumption than the white troops either in many hot climates or in the United Kingdom, only 4 per 1000 being attacked annually; it seems to indicate that the negro race is not especially susceptible of the disease in their own climate.

Tables XXVIII and XXIX indicate that not only the negro race, but the natives of India, have their liability to this disease

greatly increased by a change from their native to a foreign climate. They die of consumption much more frequently in Ceylon than when stationed in any part of India, and the native troops in the Madras Army have their liability to disease of the lungs greatly increased by a residence in China, in a latitude differing very little from their own; in their native country it ranged from 1 in 1181 to 1 in 5773 men, whereas in China it rose to 1 in 517, the mortality during five years having been at least seven times greater in China than in India.

One of the most important general facts appears to be, that the effects of change of climate over the frequency of tuberculosis, have no regular and direct ratio to any particular change. It frequently happens, that a change from a frigid, inclement, dry climate to one which is warmer and milder, although still cold, produces or increases the disease, as in the case of the reindeer brought to our menageries, or that of the Swedish troops from Bothnia and the northern provinces, residing in Stockholm or of the Laplanders in Denmark; and so, also, it is said, that the Finland youth who go to be apprenticed to various manufactories in St. Petersburg, die in great numbers of phthisis.* A similar effect also frequently follows a change from a cold, moist climate, to one which is hot and moist or hot and dry, as in the case of troops sent from England or the United States southward, as to Bermuda, the West Indies, the Mauritius or Guiana. Conversely, a change from a cold, moist climate to one which is hot and dry, or hot and moist, is sometimes followed by a great diminution of the disease, as in the case of Europeans in Ceylon, the East Indies, or the Tennesserim provinces; and even the change from a warmer to a colder and more inclement climate, as in the case of the British and Americans residing in the more northern regions of North America, has the same result; finally, individuals or races are sometimes rendered more subject to tuberculosis by change to any other climate than their own, as in the case of Africans, and probably Sepoys, who, whatever their susceptibility to the disease at home, appear to suffer from it in an increased ratio to whatever part of the world they may be transported, whether to a cold and inclement, or to a hotter, a dryer, a more humid, an equable, or a variable climate; as in the negroes resident in the United States, the West Indies, England, France,

* Brit. and For. Rev., Oct. 1840, p. 582.

Egypt, Ceylon, the East Indies, or Tennesserim. Moreover, the result seems to follow a change when the known differences of the climate are very trifling indeed, as in the case of the natives of India, in China and Ceylon, the Finlanders in Stockholm, or the Laplanders in Denmark.

In the case of the American Army recruited from various parts of the Union, and serving in a more northerly latitude, it is found, that if we contrast a climate where cold weather prevails from November to May, the general range of the thermometer being from the freezing point to 30° below zero; the summers equally remarkable for extremes of temperature, the mercury sometimes rising, in June, July and August, to 100° in the shade, a constant and rapid succession of seasons occurring, summer succeeding winter so rapidly that there is scarcely any spring,—as in the *inland* parts of the northern region of North America, and the inland posts of the American Army,—with a climate where the temperature is equable, the air more moist, the changes of seasons slower, more uncertain and variable, as on the shores of the ocean and of the lakes in the same region, tuberculosis appears to be less frequent in the former than in the latter, since during ten years, the ratio of admissions per annum for consumption was:—

At the Inland posts	. . . . .	$5^{1}/_{10}$ per 1000
„ Atlantic „	. . . . .	$10^{4}/_{10}$ „ „
„ posts on the Lakes	. . . . .	$8^{4}/_{10}$ „ „

And in the winter season the attacks annually were:

At the Inland posts	. . . . .	3·2 per 1000
„ Atlantic „	. . . . .	4·6 „ „
„ posts on the Lakes	. . . . .	4·3 „ „

Thus, a climate with a great range of temperature, a strong contrast between winter and summer, and constant and rapid changes of season, afforded a smaller amount of tuberculosis in the American Army than a milder climate, even in the winter season. (Dr. Forry.) *

These facts shew how difficult it is to establish any direct relation between any particular climatic influences, and the frequency of the disease. The migration of the human species from the more northerly regions towards the equator, appears to increase its frequency, except in the case of India, and probably the milder regions of the north of Africa and Syria; migration from the

* Brit. and For. Rev., April, 1842, p. 423.

more southerly regions northward appears, as a general rule, to increase its frequency, with the exception of very cold, dry and equable climates. So also in warmer, and even in hot climates, at certain *elevations*, where the air is more rarefied, colder, and less humid, the disease also becomes less frequent; as in the *Alps*, at such an elevation that the winters are as long and as severe as those of the north of Europe, where phthisis is said to be very rare among the natives;* and at similar elevations on the *Andes* in South America, where it is equally rare. The Spanish baths of *Panticosa*, regarded as an almost infallible remedy in cases of far-gone consumption, are seated in the Pyrenees, 5,000 feet above the level of the sea. (Dr. Burgess.) Europeans in the East Indies, although little liable to disease of the lungs in any locality, are still less on the Table lands and Plains than at the Sea coast. (Table XXVIII.)

Dr. Smith remarks, respecting a particular locality in the Andes,—"The vale of Huanuco has a daily breeze up the river Huallaga; its air is dry and warm, and carries off the perspiration of the body as fast as it is generated: so that in this sweet retreat, alike free from ague and consumption, without great exertion and exercise, one does not perspire profusely, or even so as to be very observable." He further remarks—"In Huanuco, about 7000 feet above the level of the sea, the thermometer rarely throughout the year rises above 72° or falls below 60° Fah. in the shade. But at Rhendos, a small hamlet on an acclivity about 1000 feet, perhaps, higher than the city of Huanuco, the temperature may be about 10° lower; and here persons affected with pulmonary consumption experience more relief than in the vale immediately beneath. From 8000 to 10,000 feet appears to be a very favorable elevation on the Andes, where the snow line is at 15,000 or 16,000 feet, for the recovery of those affected with pulmonary complaints. The extreme of cold seems to be as hurtful as the extreme of heat, and too rare an atmosphere as injurious as one too dense. He is disposed to believe that much of the advantage which arises to those who, affected with consumption, change the climate of Lima, and the coast in general, for the Sierra, proceeds from the change induced in the capacity of the chest, pulmonary tissues, and air-cells. For when youthful patients, especially, are transported from the coast to the Sierra, by gradual

* Laennec, Trans. by Dr. Forbes, p. 329.

stages, as suited to their actual state of weakness and disease, Dr. Smith asks—is it not reasonable to think that the pulmonary organs and thoracic cavity will be gradually enlarged, and adapted to the rarer atmosphere of elevated regions, as we find to be the case with the mountain Indians?" *

3. *The Qualities of Climate which affect the Prevalence of Tuberculosis.*

On this subject a difference of opinion meets us on the threshold. According to some, climate, *per se*, considered totally apart from any of the other known influences which have been described, is a direct cause of the disease; according to others, climate, *per se*, has nothing to do with it, and its occurrence or not, in different climates, as also its relative frequency, are wholly attributable to the hygienic circumstances under which the people are placed, and to their occupations and modes of life, so that under similar anti-hygienic influences the disease is equally liable to occur in all climates.

There are absolutely no facts to establish that climate alone is adequate to the production of the disease; at the same time a total negation of the influence of climate is totally unwarranted. In the case of man and animals transported from one climate to another, where, as a general fact, tuberculosis results, they have always been subjected to one or more anti-hygienic influences in addition to the change. Nevertheless the facts very unequivocally establish that climate materially modifies the effect of these influences. Change of climate in most cases necessarily involves change of hygiene, which may be for the better or worse as respects the production of tuberculosis. The prevalence of the disease amongst the natives, compared with their modes of life and occupations, must therefore be the great criterion of the influence of particular climates. The prevalence of the disease among individuals transported from any particular one to different climates is next in importance as a criterion, as in the case of the British, French, and American troops in different parts of the world; here the analogous and in many respects identical habits of the troops, render the comparison all the more close; but it must not be forgotten, that a certain proportion carry with them the tuberculous predisposition, and that they are all more or less subject to

* On the Diseases of Peru, Edin. Med. and Surgical Journal, vol. lviii, p. 63.

many anti-hygienic influences, as the depressing passions, sleeping in barracks, and barrack discipline generally, sexual vices, and the like. A similar illustration is furnished by the African races taken into slavery in different climates; tuberculosis is produced whether they are taken to climates in which the disease is very prevalent, as the United States, or to those wherein it is very infrequent, as Egypt; and in both instances by the force of anti-hygienic circumstances. The cases of least weight in forming an opinion on the influence of climate are those in which the inhabitants of one climate emigrate to another, inasmuch as facts diametrically opposed, as regards climate *per se*, present themselves; in warm regions of the globe the natives of cold climates frequently become tuberculous, in cold and damp regions the inhabitants of warm climates more frequently become so, and the difference which exists may frequently be shewn to depend upon differences of hygiene.

If this view could not be received, it would amount to the admission that the constitution of man is adapted *only* to the climate where himself and his ancestors are born, but whatever the influence of change of climate, it would appear that, *cæteris paribus*, in the main, man, and probably animals, are as liable to the disease in their native countries as they are when transported to foreign climes.

Where tuberculosis appears to result from change of climate, it is as difficult as in other cases to determine the precise influence by which the effect is produced. Animals are subjected to restriction from exercise, to confined air, and unnatural diet; and a violence is done to their instincts. Negroes are subjected to similar influences, with the addition of the depressing passions. Troops are subject to close barracks and military discipline. These causes are adequate to produce the effect wherever they are in operation. But the disease results from change of climate where it cannot be referred to such agencies. In many of the instances the change has been from a warm and dry to a cold and damp climate, as from Sennaar and the burning sands of Africa to the colder and moister climate of Egypt, or of the island of Ceylon; or to the moister climate of the West Indies; or the very decidedly cold and moist climate of England. In France also, negroes and creoles are said to die of inveterate tuberculosis. French regiments serving in Holland furnished a much greater mortality

from phthisis than regiments from the same country serving in Italy and Spain.

In many of these cases there is no suspicion of hereditary transmission, and the disease must have been produced in the individual. From Casper's tables, and the army statistics published by Col. Tulloch, and from other facts detailed in this article, the conclusion appears to be inevitable, that the known states of the atmosphere and weather in the north and south temperate and torrid zones, exert no uniform or positive influence over the mortality from phthisis. It has been shewn clearly that some of the most prominent of the climatic influences alone are totally inadequate to the effect of producing tuberculosis, and that some of the anti-hygienic influences will produce it in any climate and at all times, and inasmuch as in a majority of cases the agency of the latter is very obvious, we are led to the conclusion that the former play but a subordinate part.

Troops stationed in the West Indies are generally about twice as liable to death from consumption as those which remain at home, but the circumstance that this excess of mortality affects the men, and that the officers are to a great extent exempt (p. 493), shews that the result is not attributable to climate only. Col. Tullock states, on statistical data, that it is not at all probable that either exposure to night air or intemperance is the cause (West India Report, p. 100); so that, as before stated, we must fall back upon barrack discipline in connection with climate.

It is then totally impracticable to estimate the effects of climate or of locality, without in the first place taking into account the *occupations* and *modes of life* of those subjected to its influence; since it has been shewn that the occupations of a community influence very materially the production of the disease. One country in which the inhabitants are generally engaged in agriculture and out-door employment, for instance, or peopled with nomadic tribes, may exhibit an exemption, and another, composed of factory labourers, prisoners or large communities collected into towns, the greatest prevalence of the disease, without the slightest relation subsisting between these results and the respective climates. So also as respects different localities in the same country, we are liable to be misled by statistical figures if we do not take into account the modes of life and occupations of the inhabitants.

The subject of *season* has already been treated of (p. 507). The

effect of the continuance, or very constant operation, of particular states of the *weather* and atmosphere over the prevalence of tuberculosis, cannot be determined by the mortality of particular forms during atmospherical states of short duration, but even as respects the latter, erroneous prejudices prevail. It is tolerably certain that the pressure, temperature, and hygrometric states of the atmosphere have a very trifling influence, even over the mortality from phthisis. (Table VIII.) The greatest barometrical variation, as occurring in Berlin during nine years, exhibits, according to facts collected by Mädler, comprising 11,472 deaths, but a very slight influence indeed. From that influence it would appear, that a small proportion fewer dies when the pressure is high than when low, — the reverse of which occurs in the general mortality of the population. According to Mädler's statistics also, variations of temperature have even less to do with the mortality from phthisis than the fluctuation of pressure. The greatest variation occurred in the winter of 1831, and the smallest in 1832, with scarcely any difference in the number of deaths from phthisis in these two seasons. The hygrometrical state of the atmosphere appeared to have some influence; thus the deaths from phthisis were :—

In dry Winters	367
In Winters partly dry and partly humid .	338
In dry Summers	291
In mixed Summers	289
In dry Autumns	298
In mixed Autumns	263

From which it would appear that a certain degree of humidity diminished the tendency to death from phthisis.

The *diet* of the population of different countries also requires to be taken into the account, although there is no ground for the belief that any modification of diet can alone produce the disease (p. 446).

There is a curious coincidence which may be here mentioned. The human race admits of a trifold division, according to the food they eat, corresponding with the meteorological regions. The inhabitants of the polar regions are in the main *carnivoræ*, subsisting principally on fish and seals; those of many tropical climates are *frugivoræ*, living chiefly on the fruits of the plaintain and the palm; those of temperate regions are *omnivoræ*, living on a mingled animal and vegetable diet. It appears pretty certain that

the latter are most prone to the tuberculous transformation of the blood; and this is not only the case in the temperate zone, but in the torrid zone, in some parts of which, where the diet is mixed, as in the West Indies, the disease is very frequent, and in others, where it is to a very great extent herbaceous, as in the East Indies, the disease is very rare. In Syria and Egypt the diet of the poor in many localities consists of pulse, olives, peas, black bread, and rice; yet tuberculosis, either in the form of scrofula or phthisis, is extremely rare.

Thus, under the head of climate, in relation to the etiology of tuberculosis, the most intricate combinations of circumstances are implied; temperature, humidity, variability, density, and other properties of the atmosphere, the soil, food, modes of life, customs, occupations, temperaments, and races of the inhabitants; hence the gross statistics, in which no account is taken of the particular influences, or the particular combinations of influences, brought into play, are of comparatively little service.

In explanation of the occurrence of the disease after change from a warmer to a colder climate, it has been said that the lymphatic temperament prevails in warm climates, and that negroes and creoles are examples, and more especially that the function of respiration being less necessary to sustain the vital heat in warm climates, and disease being in direct ratio to the activity of function, hepatic disease is more frequent in such climates, and conversely, pulmonary disease more frequent in cold countries; and that the inhabitants of warm countries transported to colder regions become more liable than others to tuberculosis; but the facts are against this explanation; negroes are as liable to the disease in a warmer as in a colder climate than their own.

Dr. Burgess, in his essay recently published, reasons upon the principle that "Nature has adapted the constitution of man to the climate of his ancestors." * "The natural climate of man is that in which not only he himself was born, but likewise his blood relations for several generations." This is undoubtedly an important consideration. When we regard the large number of the elements of matter which enter constantly into the composition of the blood of animals, and that in all probability each of these is necessary to the constitution of the blood as a whole, and has its special ulterior use in the economy; when we consider also, that

* Climate of Italy in relation to Pulmonary Consumption, 1852.

the functions and faculties of man are all in direct relation to the physical agents which surround him, and take a comprehensive view of the known defects and disturbances which result from excess or deficiency of many of these,—as of oxygen—iron—carbon —and our total ignorance of the real uses of the majority of them, as of the sodium, potassium, ammonium, manganese, silica, probably copper, &c.; we cannot fail to admit the probability of the adaptation in question, and that the air, water, and vegetation of a country, or of a locality, is, *cæteris paribus*, best adapted to the constitution of the blood and of the organic structure of its inhabitants. Admitting all this, it must also be admitted that excesses or deficiencies in the elements of the same air, water, and vegetation, may imply excesses or deficiencies in some one or more of the essential constituents of the blood of animals, and the deterioration or premature decay of individuals or species. But since, as respects tuberculosis, the particular excess, or change, or combination of the organic elements which constitutes the essence of the disease is unknown, we are thrown upon direct observation and empirical experience, as to the real influence of climate in producing or preventing the disease.

The case of the East Indies affords the best instance of the effects of climate in ameliorating the tendency to tuberculosis, and probably of correcting the tuberculous state of the blood. It is probable that one-fourth of the Europeans who migrate there are hereditarily affected with the tuberculous predisposition, and yet a very small proportion indeed fall into active tuberculosis, or die of any form of the disease. The disease is also comparatively infrequent among the inhabitants. It becomes a great question whether the qualities of the climate, or the modified habits of the inhabitants and of emigrants, has most to do with this exemption. The circumstances of air, &c., of Europeans in London, and in Calcutta or Bombay, contrast greatly. The comparatively small and close rooms, the mode of heating apartments in England, the imperfection of ventilation in towns, streets and houses, the great number of hours spent within doors, in close sleeping rooms, and in close carriages, present all the elements for the production of the disease here; while the more spacious apartments, and the out-door habits, the habits of complete ventilation, and of almost constant exposure to the open air, are totally opposed to its production in the East; and where we find that the result of the withdrawal of these

sanitary influences, even in the East, is the production of the disease, as in the case of half-castes and natives, and in the interior of jails, it becomes probable even here that the climate may have but a secondary importance in reference to etiology; nor ought the effects of a long sea voyage to be overlooked, which has been one of the most important circumstances incidental to change of climate from Europe to India, particularly in the case of troops. Next to the East Indies, the change from Europe to Canada seems to have been attended with the best effects in modifying the constitutional tendency to the disease.

In fact, the statistics lead to one general conclusion, viz., that as respects the etiology, the habits and customs of mankind ride over all climatic influences; that if the European inhabitants of Calcutta or Alexandria were to adopt the modes of life pursued in the metropolis of the British Empire, tuberculosis would, after a period, be as frequent in those localities as they are here; and conversely, if the inhabitants of the densely populated countries of Europe were to improve their habits and customs as to labour and rest, in-door and out-door occupation, the size, construction, modes of ventilation and sites of their houses, streets and towns, with other circumstances of hygiene, after a sufficient period had elapsed for hereditary influence to wear itself out, that they would probably be more free from this disease than the inhabitants either of Lapland, Canada, Greenland, India, Egypt or Ceylon.

No more appropriate illustrations of the general etiological doctrine here inculcated could probably be found than the following interesting account, given by Mr. Power, of the liability to tuberculosis of the inhabitants of *Van Dieman's Land,* under hygienic circumstances foreign to their natural state, with which I terminate this section.

Mr. Power states, as respects this colony, certainly there are not now, whatever may formerly have been the case, sufficient grounds for its possessing the reputation of an immunity from pulmonary consumption. Cases of tubercle in the lungs, though by no means of such frequent occurrence as in European countries, have been met with in all classes of the inhabitants; namely, in those who have emigrated from other places, in those born there of European parents, and in the aborigines. Amongst the last it has, in the majority of cases, been the fatal malady by which their numbers have been reduced to the miserable handful which now remains of

them. Generally speaking, however, consumption is not in that climate a disease which by its frequency obtrudes itself on the attention, excepting in the instance of the aborigines. The most sufficient reasons for its existence, or perhaps development, among the latter, are to be found *in the total change of habits, diet, and general mode of life to which they have been subjected since their capture and confinement.* Formerly, living in tribes, they migrated from one part of the country to another, according as a necessity for food, or some more capricious motives, swayed them. When the early settlers arrived, their frequent depredations and the consequent reprisals produced mutual feelings of animosity, which but too frequently terminated in a loss of human life. Under such circumstances, and their total numbers besides being small, it was considered advisable to confine them to one district. For this purpose, Hinder's Island, a small island in Bass's Straits, was selected, and to it they were all accordingly transferred. Provisions, clothing, dwelling places, and proper superintendants, were furnished by the government; but to a wandering race accustomed to rove at will through a large and extensive country, to procure their food, as they pleased, by fishing and hunting, and, regardless of dress, to live where and how they liked, this confinement to a narrow little island, and immediate change from their own free and unfettered habits to the more constrained and artificial ones of civilized life, proved speedily fatal. They died in great numbers, and in the majority of cases pulmonary consumption was the disease under which they sank. An improved system of management, by which their present mode of life is made to assimilate more nearly to their former habits, has of late years been introduced, and it is satisfactory to know that the mortality at first observed has during the latter period much diminished. With the exception, then, of these poor creatures, and those instances where the seeds of that fatal disease were formed before leaving this country, tubercular phthisis is very rarely met with.*

To grapple effectually with this comprehensive, difficult, and intricate, but intensely interesting and highly philosophical subject, would require an amount of space, time and talent, which it does not fall to our lot to bestow.

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* Dr. Power on the Climate of *Van Dieman's Land.* Dublin Journal, vol. xxiii, p. 88.

SUMMARY.

Numerous as are the facts contained in this chapter, and lengthy and important the details, the whole subject admits of a short summary :—

1. The causes by which a tuberculous state of the blood may be produced are predisposing or inducing causes.

2. The predisposing causes are either physiological or pathological. They can never of themselves produce the disease. The predisposing physiological causes consist chiefly, of the state of the blood incidental to infancy and the earlier periods of life, and of the modified condition of the blood, arising from its rapid and disproportionate renewal after it has been wasted or destroyed, at any period of life; the conditions of the blood in the female sex and the lymphatic temperament also operate to a slight extent. The predisposing pathological causes consist of all those states of the blood, produced by diseases and etiological influences, which dilute and deteriorate it, diminishing its vital power and debilitating the whole constitution.

3. The most efficient of the true causes, or those influences which are most powerful in inducing the disease are—a vitiated atmosphere—insufficient muscular exercise—and the depressing passions. The whole of these influences meet, as it were, at one common point, and have probably one essential modus operandi; viz.—an insufficient renewal of pure atmospheric air, or an abnormal condition of the air habitually contained within the chest.

4. Defective diet is the next in importance as a cause; but while it is unquestionable that, notwithstanding the best diet, the last mentioned agencies will produce tuberculosis, there are absolutely no facts to shew that the disease is attributable, in any case, to diet alone. Defective diet stands, therefore, as the most powerful cause ancillary in its operation to one or more of the causes previously assigned.

5. There are many other ancillary causes, as, for instance, the continued operation of cold, particularly through the medium of insufficient clothing in a cold climate; uncleanliness, and all those influences which arrest or diminish the cutaneous functions, also those which indirectly confine the respiratory functions; as the respiration of too dense or too humid an atmosphere; or those influences which diminish or retard the hepatic or digestive functions, or lead to congestions of the chylopoietic viscera; also every

influence exerted upon the animal economy which has the effect of exhausting the nervous powers and producing debility, whether direct or indirect; as sedative agents, sexual excesses, and the like. Agencies of a totally different and even opposite nature, hygienic in their mean ranges, become anti-hygienic in their extremes, and may produce their injurious effects on the animal economy, by a similar modus operandi.

6. The disease is most frequently produced by a combination of agencies, incidental to the modes of life and occupations of individuals, classes, or communities; and in all the least equivocal instances of its production by any particular mode of life, as by continued residence in prisons, hospitals, schools, or barracks, or by in-door and sedentary employments, those influences which modify the true process of respiration (No. 3), are without exception found to be in operation; moreover, statistics appear to establish, that the former, or more general agencies, produce effects in *proportion* as the influences last referred to are in play.

7. Without questioning that tuberculosis is more frequent in one climate than another, and that the salubrity or insalubrity of a climate has a remarkable effect in promoting or preventing the development of the disease, even climatic influences appear to be referrible to the same general principle, producing effects ancillary to the more efficient causes and operating through the respiratory powers and functions.

8. The causes of tuberculosis—predisposing and inducing—are frequently in operation coetaneously with the exciting causes of local disease, as in the Sheffield grinders, who are exposed, on the one hand, to the production of the diseased condition of the blood, and, on the other hand, to the excitement of affections of the lungs; and in all such cases the two series of circumstances, in their etiological relations, require to be carefully distinguished.

9. However induced, tuberculosis is liable to become hereditary, especially in the form of a predisposition, or a modification of the constitution, the same in nature as the disease itself; and in all dense communities where the disease prevails, a great proportion of the cases own an hereditary descent.

10. A debilitated constitution, operating as a predisposing cause of the disease, may be produced in the embryo and fœtus, by various sexual influences, and by defects, incongruities, and diseases, in the parents; and there is some ground for the belief, that a tubercu-

lous state of the blood, and the tuberculous predisposition or constitution, may be in this way engendered. (pp. 389—94.)

11. The original causes of the disease are more certainly and more intensely effective where the predisposition exists.

12. The true cause of the disease is still unknown. There are certain external agencies which, in the present state of physical science, it would be unphilosophical to overlook, while it is impossible to assign the relation they bear to the etiology, such as the abstraction of the genial influence of the solar rays, and the operation of the forces of electricity and magnetism; and it is necessary, in continuation of the enquiry, to bear in mind the laws of electro-physiology, the magnetic properties of oxygen gas, the correlation of the physical forces as respects each other, and the correlation of the physical and vital forces.

CHAPTER VI.

ON THE ESSENTIAL NATURE AND GENERAL PATHOLOGY OF TUBERCULOSIS.

SECTION I.

THE ESSENTIAL NATURE OF TUBERCULOSIS.

A great variety of views have been entertained of the essential nature of tuberculosis, differing from each other very widely, and sometimes totally opposed. These views are altogether theoretical, and they have been proposed in all ages for the purpose of explaining the symptoms of the disease. They have always partaken of the prevailing medical theories of the day, and they are in some measure illustrative of the successive phases of medical doctrine. At a period when medical science, by improved methods of investigation, is advancing in the direction of a more accurate knowledge of the nature of diseases, it is impolitic altogether to disregard these views, but any lengthened account of them would be unprofitable; I therefore place before the reader an abstract of some of the more remarkable, and will give a more detailed account of a few of those which have more recently excited attention.

A.—EXAMPLES OF THE THEORIES OF TUBERCULOUS DISEASES WHICH HAVE PREVAILED IN DIFFERENT AGES OF THE WORLD.

These examples have been collected, mainly, from Dr. Young's *Treatise on consumptive diseases*, from several monographs on scrofula, and in particular Dr. Glover's recent publication, and from the original authors. The Italian references are extracted from M. Louigi Parola's *Treatise on tuberculosis.*

Hippocrates, b.c. 432.—*Scrofula.*—A lymphatic temperament and an exudation of a morbific humour. *Consumption.*—A defluxion of matter from the head corroding the lungs.

Aristotle, b.c. 343.—*Consumption.*—A specific contagion. (Young, p. 121.)

GALEN, A.D. 170, 180.—*Consumption* (*Phthöe*).—Follows Hippocrates. An ulceration which eats into the lungs, so that the whole body is consumed thereby; depending on a certain constitution produced by the influence of a morbific cause. Tubercles formed by glutinous, thick, or certain other humours in the lungs. Distinguished the symptoms of tubercles from those of bronchitis.

ARETÆUS.—*Consumption* (*Phthöe, Phthisis*)—An abscess of the lungs, attended with constant cough and with bloody or purulent expectoration.

CÆLIUSAURELIANUS.—*Consumption.*—A mixture of the *strictum* and *laxum* of the methodic sect.

AMBROSE PAREY, 1579.—*Scrofula.*—A gross, cold viscid humour, mixed with melancholia. The local disease bearing a proportion to the materies morbi.

SENNERTUS, 1627.—*Consumption.*—An acrid sanies generated in the lungs.

SYLVIUS DE LA BOE, 1650.—*Scrofula.*—The first to intimate the connection between scrofula and consumption. *Consumption.*—Scrofulous degeneration of insensible glands in the lungs. Believed that tubercle arises from certain glands in the lungs, resembling those of the neck and mesentery; an opinion subsequently adopted, with some modifications, by Willis, Morton, Sauvages, Webber, Portal, Broussais, and others.

CHRISTOPHER BENNET, 1654.—*Consumption.*—The blood contaminated by unwholesome vapours, damp, inclement winds, errors of diet producing bad chyle, unsuitable labour, want of exercise, sadness of mind, &c. A low vitality of the blood. (*Theatrum Tabidorum,* p. 138, &c.)

THOMAS WILLIS, 1660.—*Consumption.*—An acidity of the blood; a general acrimony of the humours and a wasting away of the body from a base conformation of the lungs. Condemned the definition of phthisis as an ulcer of the lungs; as in some cases he found only tubercles or calcareous and sandy matter.

WISEMAN, 1676.—*Scrofula.*—*Scrofula* and *phthisis* identical. A peculiar acidity of the serum sanguinis, which coagulates and hardens glandule, membrane or muscles, and dissolveth and rotteth the bone.

Richard Morton, 1680.—*Consumption, Tubercle.*—Distinguishes between atrophy and consumption. *Consumption*—a peculiar morbid secretion, by muciparous glands, of lymph from the blood, and a depraved condition of the blood, the chief elements. *Seat of Tubercles*—the pulmonary vesicles and ultimate bronchial ramifications. *Phthisis*—either congenital or acquired—chronic or acute. Thus, he regards consumption as a pulmonary tuberculosis, caused by a morbid state of the blood, which may arise from a vicious conformation of the chest, or from other direct causes; or may depend on other diseases capable of generating an unhealthy lymph, or an alteration of the blood. He distinguishes a three-fold variety of tubercles—1. Semi-purulent. 2. Having a steotamatous appearance of various colour and consistence. 3. Resembling the medullary substance of the brain. Pointed out the frequent connection between scrofula and tubercles. (*Phthisicologia.*)

Etmuller, 1680.—*Consumption.*—Said to be the first who confuted the error, that any phthisis is produced by a fluxion from the head.

Sydenham, 1680.—*Scrofula, Consumption.*—An acrid humour, by means of the salivary ducts and the glands of the fauces is carried through the trachea into the lungs. A crude phlegm formed in the lungs and a putrid miasm scattered over the body. Phthisis is scrofula of the lungs.

Boerrhaave, 1709.—*Consumption, Scrofula.*—A conversion of the blood and chyle into pus. A depravation of the humours from a putrid cacochemia.

Marten, 1722.—*Consumption.*—Animalculæ in the lungs. (Quoted by Dr. T. Reid, 1785.)

Wepfer, 1727.—*Consumption.*—Quoted by Bonnet—explained for the first time the origin of the pulmonary cavern—"pulmonary vesicles, the walls of which are like to the web of spiders, partly become thickened, partly are broken, so that from many vesicles one or several large caverns result." "Crude tubercles precede this calamity."

Van Swieten, 1741.—*Consumption.*—From putridity. Insists, that the affection of the lungs is that most frequently connected with the various kinds of consumption, described by his predecessors.

GIRTANNER, 1743.—*Scrofula.*—Debility and irritation of the lymphatic system.

CHARMETTON, 1752.—*Scrofula.*—Fixed or volatile salt, with acid, or bitter earthy particles, which thicken the juices, especially the lymphatic fluids. (*Essai théorique et Pratique.*)

BORDEAU, 1760?—*Sturma.*—A peculiar acid in the blood, producing an acid coagulation of the serum.

MORGAGNI, 1761.—*Consumption, Scrofula, Tubercles.*—With Sylvius and Morton, says the consumptive constitution is always manifested with tubercles; these, the result of bad nourishment, from disease of the stomach. Gives cases in which internal tubercles and scrofula are conjoined. From observations by Valsalva, proves the superior lobes of the lungs the principal seat of tubercles, and gives as a reason that they are less active in respiration, owing to their distance from the inferior ribs and diaphragm. First made known tuberculization of the bronchial glands, admitting the possibility of their communicating in disease with the bronchial tubes. Perhaps the first to describe the miliary form of tubercle.

DE HAEN, 1761.—*Scrofula, Consumption.*—Alteration of the fluids consequent on the small pox. Pus in the blood in the form of a noxious humour.

CULLEN, 1777.—*Scrofula, Consumption.*—Probably some noxious acrimony of the fluids. Expectoration of purulent matter, probably containing the same noxious acrimony that prevails in scrofula, but may sometimes be exanthematic or syphilitic.

JOHN BROWN, 1780.—*Consumption.*—A mixture of the sthenic and asthenic diatheses. *Scrofula.*—Local debility. A want of due balance in excitability between the lymphatic and other parts of the system.

BAUMES (Montpellier), 1783.—*Scrofula.*—Considered that he had proved the existence of an acid principle of a phosphorous or phosphoric nature, which in the first instance thickens the lymph, and renders it liable to concrete, and ultimately tends to putridity. He founded this theory upon a presumed connexion between scrofula and rachitis, and scrofula and gout; upon the frequency of affections of the bones with destruction of their earthy material; upon the acidity in the early stages and the acrimony in the later stages, of the

secreted fluids; upon the collections found after death of phosphatic salts in the glands and viscera; and upon an observation of his own, that in the earlier stages of scrofula, and even before local disease declares itself, the urine contains a diminished proportion of phosphates; whereas, in confirmed cases, according to Fourcroy's analyses, the phosphates are increased. Baumes remarks that it is uncertain whether this "acido-putrid" depravation takes its origin from the morbid blood in its passage through the glands, or from a fluid exhaled from the blood into the general cellular system, or whether it is formed primarily within the lymphatic vessels. Hufeland entertained a similar idea of an acid principle in the lymph, and the whole theory of tuberculous diseases has frequently been founded on this assumption. *Consumption.*—A specific contagion distinct from scrofula.

Dr. White, 1788.—*Scrofula.*—Obstructions of the lymphatic system by a viscidity of lymph, all the humours having a tendency to become acid.

Rush, 1793.—*Consumption.*—Not identical with scrofula. Depends on debility—a primary affection of the system, not of the lungs.

Weber, 1793.—*Scrofula.*—Excess of oxygen.

Dr. Beddoes, 1793.—*Scrofula.*—Deficiency of oxygen. Inirritability. *Consumption.*—Hyper-oxygenation of the blood. Oxygen (the acidifying principle) combines with the purulent matter, and thereby tends to enlarge pulmonary ulcers. Florid colour of the blood, redness of the tongue and lips, and the blush on the cheeks shew that the blood abounds in oxygen. High situations suitable for the consumptive, as containing less oxygen.

Sœmmering, 1795.—*Scrofula.*—Relaxation, debility, and dilatation of the absorbent vessels.

Baillie, 1795.—*Tubercles.*—The essential cause of consumption. Found them in children from two to three years old. Demonstrated their seat in the cellular tissue, and their nature as different from that of glands.

Sprengel, 1796.—*Scrofula.*—Quotes another author, that it depends upon a peculiar virus and a viscous state of blood, with the development of an *aeriform* fluid in the body.

HUFELAND, 1797.—*Scrofula.*—A deep-seated atony of the lymphatic system, accompanied with a specific irritation of this same system and a particular alteration of the lymph—an acid acrimony of the lymph.

DR. T. SUTTON, 1799.—*Consumption.*—Obstruction of the mesenteric glands, the proximate cause of all the circumstances belonging to the disease. The fatality of this disease is not owing to the hectic fever nor to the local affection of the lungs, but the chief cause of the emaciation and debility is some disease of the abdominal viscera. The blood is diseased, there being "a deficiency of gluten," occasioned by the nourishing part of the food being prevented arriving in the blood-vessels. Refers to the connection subsisting between mesenteric disease and phthisis; to the fact, that many cases of phthisis are preceded by affections of the bowels, and that consumptions frequently succeed to protracted dysenteries and other chronic complaints of the abdominal viscera. The affection of the mesenteric glands adequately accounts for the "most important symptom"—the emaciation—and this symptom precedes any material disease of the lungs.

CABANIS, 1804.—*Scrofula.*—Atony of the lacteals and ganglions, and exaggeration of the lymphatic system.

BROUSSAIS, 1804, 1808.—*Consumption.*—Depends on a chronic phlogosis, inflammation of the lungs or catarrh, parenchymatous or bronchial, which, if prolonged by the cause that produces it, could impress the lymphatics of the lungs with a certain impulse leading to the formation of tubercle or various deposits of tubercular matter. He states, that inflammation of the pleura, leading to compression of the parenchyma of the lungs, may determine the development of tubercles. "As every pulmonary inflammation, when prolonged, may determine lymphatic inflammation, therefore the production of tubercles should be attributed to the continued inflammatory action of bronchitis, pneumonia, pleurisy, &c." He admitted, however, that in certain very weak individuals, tubercles develope themselves without the symptoms of inflammation; but his theory is, that tubercles are in fact always the result of inflammation.

DR. PARR, 1809.—*Scrofula.*—A redundancy of albumen in early

life, with an excess of oxygen and a deficiency of azote, producing a lentor in the circulating fluids.

Bayle, 1810.—*Tubercles, Consumption.*—First employed the term "tuberculous diathesis." Designated the liability to phthisis by this name—on the principle of tubercular degeneration; that is to say—disposition to the disease. "Before his time, the theorists could not conceive any morbid deposit, suppuration or ulceration, without preceding inflammation of the affected viscus"—he denied the origin of tubercles from a pre-existing inflammation of the pulmonary tissue. Establishes two fundamental characters of consumption—the essential anatomical character and the symptomatic. The anatomical character had been neglected before him, hence the same name was given to diseases presenting analogous symptoms but differing entirely in their nature. From the pathological appearances in the lungs he constructed six species of consumption. By the advance of pathology this arrangement has been totally revised. He distinguished the anatomical and symptomatic differences between consumption, bronchial catarrh, pneumonia, and chronic pleurisy.

Dr. Ambri.—*Consumption.*—An immediate but secondary effect of a necessary predisposition. The organic vice not hereditary, but children acquire from the parent the disposition to the disease. Without the predisposition, the organic vice generating the disease could not have place. From the irregularity of atmosphere and temperature arises inflammation of the respiratory organs—acute or chronic—hence that pathological condition which constitutes consumption. (*Dic. Class de Med.*, tom. xlv, p. 170.)

Dr. Bettoli.—*Consumption.*—Caused by an organic preformation. The consumptive person carries within himself the preorganic infirmity, ready to develope itself under a favourable concourse of particular circumstances. (L. Parola.)

Tommasini, 1817-20.—*Consumption.*—The effect of a disorganizing and inflammatory process. Allows a special diathesis or dyscrasy of its own kind, apart from the inflammatory condition, which may arise from inadequacy of *stimuli* or aliment, or real debility, or the introduction of a poison or an insalubrious principle, altering the quality or decomposing

the liquids and solids; changing the organic mixture, the nutrition, the reproduction; and from thence corrupting the viscera and system, degenerating the tissues and humours, and leaving the individual a prey to consumption. (*Della Inflammat. e della Feb. Cent.*, t. iii, p. 634.)

Dr. Baron, 1819.—*Tubercles.*—Hydatids.

Dr. Padlini, 1835.—*Consumption.*—Does not spare the most robust individuals, who become its victims in the vigor of life; yet there exists some cause that tends to exhaust the vital force, the organic assimilation, the hæmatosis, nutrition. There is organic weakness of the patient, causing a precocious decrepitude. Therefore the tendency to consumption in robust subjects is in proportion to the strength of the preceding causes and to the severity of the inducing influence, as the abuse of liquors, unbecoming licenses, and excesses of every kind. (*Dict. Clas. de Med.*, tom. xlv, p. 343. *L. Parola, della Tuberculosi.*)

R. Carmichael, 1836.—*Tubercle.*—A variety of Entozoon, having a distinct or separate animal existence. Beings possessing a vitality independent of the animal in which they are lodged. (*On the origin and nature of Tuberculous and Cancerous Diseases.*)

Dr. C. Canstatt, 1841.—*Tuberculosis.*—A degeneration of the albumen and a consequent immature and abnormal fibrine; hence a defective plasma; hence the albuminous fluids preponderate, and at length the vehicle of the albumen is unable to hold it in suspension, and it is consequently deposited in the form of tubercle. (*Brit. and For. Rev.* vol. xiii, p. 341.)

Gilbert, 1842.—*Consumption.*—A want of discriminating power in the mouths of the lacteals.

Professor Buffalini, 1846.—*Scrofula, Tuberculous diathesis.*—Identical. The tuberculous diathesis a vice of the assimilating organs, arising from the scrofulous diathesis. The latter not a true morbid condition, but a particular kind of constitution predisposed to scrofula. There is an extra proportion of the earliest organic formation, *i. e.*, a prevalence of the albumen in the blood with a defect in the successive organic changes, from arrest of the respiratory process; by which

arrest, the albumen in excess cannot be changed into a more elevated organic principle. The diathesis consists not in a deficiency of reparative materials, but an insufficiency of that organic formation which is under the influence of oxygen—a defect of the respiratory function. Hence, in the cure, it is necessary to pay attention, not to nutrition, but to a better and more exalted reparation of the oxygenated principles. He advises a free allowance of animal food; gymnastic exercises, and all those things which may contribute to a more energetic hæmatosis and to a greater development of the muscular mass. (*Scientific Congress of Geneva*, 1846.)

Dr. Lanza, 1849.—*Tubercle.*—A species of phytozoon, possessing a special anatomical and physiological existence—not a mere effusion or extravasation of a morbid element from the blood, but peculiar beings or growths, implanted on certain tissues, from which they derive their nourishment, and which they injure and destroy. (*Brit. and For. Rev.*, July 1849, p. 121.)

J. C. Holland, 1850.—*Consumption.*—A disordered condition of the nervous system. *Scrofula.*—A peculiar state of the vital powers prone to the manifestation of certain morbid conditions characteristic of debility. (*On the nature and cure of Consumption, &c.*)

Professor Giacomini.— *Consumption.*—A disease proper to the whole sanguineous system, consisting in an affection of the material capillary extremities of the lungs; either primary or secondary to a congenerous malady of the whole arterial system. Thus reducing the various forms and morbid products that arise in phthisis to arteritis and its events. (*L. Parola della Tuberculosi.*)

The foregoing abstract, which might have been greatly extended, will be found amply sufficient to convey to the reader an idea of the diversity of opinion which, in all ages, has prevailed, as to the true nature of this disease, and of the unsettled state of the professional mind, even in our own times. I propose now to describe somewhat more fully, a few of the doctrines which at present excite attention, particularly in our own country.

B.—THE THEORIES OF TUBERCULOSIS IN WHICH THE DISEASE IS REFERRED TO SOME ERROR IN PRIMARY DIGESTION.

Some of the most eminent modern writers refer to digestion in the first passages, either for the proximate and essential cause of the disease, or for some aberration which is necessarily related to the proximate cause, and uniformly present. On examining, however, the particular views of writers of this class, it will be found that they differ from each other very materially. This difference refers to the particular organ supposed to be at fault; and there are no specific views as to the nature of the morbid product which, if the primary cause of the disease be located in any organ subservient to this process, must be the result of the error of digestion. It has not been shewn that tubercle, or any substance which can be regarded as its analogue, is ever found in the products of digestion so long as these are confined to the alimentary canal.

(*a*) *The Generation of an Acid in the Primæ Viæ.*—Mr. Carmichael, in his Essay on Scrofula, published in 1836, referred the disease primarily, to a disorder of the digestive organs, most frequently produced by want of exercise; and considered its proximate cause to be, the generation of an acid in the primæ viæ. The doctrine is essentially that of Willis, Wiseman and Baumes; the acid principle originating, according to Mr. Carmichael, in the first passages. The very frequent occurrence of an excessive acidity in the contents of the alimentary canal has given considerable countenance to this doctrine; but Mr. Carmichael's own expressed views cast upon it, at least a doubt, for he states as a general principle, that the chief cause of indigestion is a vitiated secretion of the gastric juice and bile, originating in a natural weakness of fibre, and languid circulation. He states, as we think without proof, that the acidity of tuberculosis (scrofula) is not the result of this debility, but is the direct effect of insufficient exercise upon the digestive functions. Tuberculosis in all its forms occurs without any evidence of the existence of this excess of acidity; when the acidity occurs it is invariably accompanied with the signs and symptoms of the debility so justly referred to by this author; and the debility of the digestive organs, whether in the tuberculous predisposition (p. 40), or in tuberculosis in any of its active forms (p. 84), is only a part of the universal direct debility (p. 81, 105) which prevails; so that this acidity cannot be regarded as the proximate cause of the disease.

(*b*) *A Plethora of the Vena Portæ both in its roots and branches.*—In the Cyclopœdia of Practical Medicine, Dr. Todd propounds the doctrine, that "Strumous Dyspepsia" has an important share in the development of the tuberculous constitution, and that the plethora here indicated is the proximate cause of this form of dyspepsia. This has been adopted as the proximate cause also of the disease, but similar objections apply here as under the last head. Frequent as this form of dyspepsia is, there is reason to think that it has been too much dwelt upon. There can be no doubt that this plethora frequently takes place, but plethora alone will not enable us to explain, even the symptoms of strumous dyspepsia, and every evidence, or even suspicion, of the existence of this plethora is frequently absent.

(*c*) *An Imperfect Development of the Chyle and Lymph Granule.*—According to Professor Shultz,* tuberculosis derives its origin both from primary digestion and the formation of the lymph. Admitting some disarrangement of the essential constituents of the blood, he traces it to imperfect digestion, producing imperfect development of the chyle or lymph granules. These granules ultimately become blood corpuscles; when they are defective in the lymph, in the first stage of their development, they give rise to irritation and inflammation of the glands, or scrofula. The products of digestion handed over to the lymphatics for the renewal of blood, are chiefly fat and albumen, and M. Shultz shews, by direct experiment, that if an animal be fed on oil only, without albumen, the chyle contains, instead of the proper chyle granule, round fat-globules; and its plasma—the liquor chyli—seems to be imperfectly formed, and its coagulating power weak; under these circumstances no blood corpuscles are formed around the chyle granules. An analogous effect upon sanguification is produced when an animal is fed only on starch. Hence, a defective state of the liquor sanguinis, a defective energy of the whole formative process, and, in fact, that degraded vitality which we have described as an essential part of the disease (p. 15).

The imperfect development of the chyle and lymph granule in tuberculosis, upon which this theory proceeds, has not been verified by the observations of microscopists, and if it were, the considerations set forth under the last head would still obtain. The question would still remain, whether the causes of the disease

* Brit. and For. Rev., July 1843, p. 208.

influence the formative process of the chyle granule directly or indirectly.

As respects the whole of the theories which refer tuberculosis, in its origin and essence, to any form of dyspepsia, the point to be determined is, whether the imperfect digestion of food, or the dyspeptic symptoms, result from the direct agency of the inducing causes of the disease upon the digestive *powers* and *functions*, or whether they result from malnutrition of the *organs*, and a defective state of the *digestive secretions*, proceeding from a primarily induced morbid condition of the blood. The symptomatology and the pathological anatomy afford, as we think, a definite reply to this question. As already stated in full (p. 84), the dyspepsia is sometimes totally absent. Many tuberculous individuals not only arrive at the stage of the deposit of tubercles in an organ, as the lungs, but they pass through the first and second stages, and even the fatal stage, without a dyspeptic symptom; with the exception perhaps of the colliquative diarrhœa; and on post mortem examination, the digestive and chylopoietic viscera often exhibit no morbid change except the atrophy, which is common to the whole of the mucous membranes and other structures.

That tuberculous children should exhibit the symptoms of strumous dyspepsia, as a very constant effect of a tuberculous state of the blood, is by no means surprising, when we consider the delicacy of their structures, and the facility with which the digestive organs are deranged, in early life, by a vitious diet and other causes. As respects adults, in England we are proverbially dyspeptic. Fournet appears to represent the French, affected with this disease as less liable to the complication in question, and Dr. Sweet, the latest American author, states the same of his own countrymen; he considers that we have attached too much importance to the dyspeptic symptoms. (Lib. cit.) Dr. Gellerstedt records, that in Sweden, of 119 fatal cases of phthisis examined carefully as to the existence of previous diseases, there were 10 only in which dyspeptic symptoms had prevailed; and of 191 other cases, affected with the disease, 32 only; that is to say, in 310 cases of tuberculosis pulmonalis 7·09 per cent. only presented a dyspeptic complication. (*Brit. and For. Rev.*, April, 1847.)

C.—THE THEORIES REFERRING TUBERCULOSIS TO A SPECIAL MORBID CONDITION OF THE LYMPH.

Tuberculosis was regarded, in its essential nature, by Charmetton,

White, Baumes, C. Hufeland, and a host of other authors, as some peculiar modification of the lymph; and Shultz's theory, already described, embraces this view. Mr. J. Simon has recently revived this doctrine. By reference to the chapter on morbid anatomy (p. 231), it will be seen that M. Andral also entertained it. Mr. Simon * believes in some misdevelopment of the proteinous ingredient of the lymph, by which, instead of remaining fluid in the liquor lymphi and liquor sanguinis, it solidifies and concretes. The solidification occurs in the "*ascensive*" development of the lymph in the lymph-vessels, or in the blood-vessels, and the more especial characteristic of the morbid element is "*precipitability*" by the action of the atmosphere; hence tubercle occurs with an infinite preference in the lungs and in the lymphatic glands, where lymph is brought into intimate relation with the arterial blood, and where lymph and blood are first exposed to increased or renewed oxidation. This accounts for venosity of blood precluding the tendency to tubercular deposit.

A reference to the chapter on morbid anatomy will very materially qualify Mr. Simon's representation of the infinite preference exhibited by tubercle for the lungs and the lymphatic glands. Witness, for instance, its frequent primary development in the bones and in the membranes and substance of the brain. Mr. Simon's theory also supposes the precipitation of tubercle from the lymph while it remains within the lymphatic vessels of the glands, and not from the extra-vascular blastema; but I do not find any facts or observations in proof of this view, and the circumstance that tuberculous glands have been injected, both by the blood-vessels and lymphatics, and the injection has passed freely through them, is against its validity. Tubercle is not developed most frequently in the glands, where we should expect to find it, if this theory were true. Neither have we any proof that it is deposited in the lungs from the blood of the pulmonary artery, or from the chyle or lymph with which this blood is mixed. On the contrary, it has been found in the arterial blood (p. 221), proceeding to diseased organs; which could scarcely have occurred if it were a precipitation from lymph and chyle by the action of the atmosphere.

D.—THE THEORY OF DEFECTIVE RESPIRATION IMPERFECTLY REPLACED BY THE LIVER.

M. Louigi Parola has lately advocated a peculiar theory of

* A Course of Lectures on General Pathology, 1850.

tuberculosis.* He associates the function of the liver with that of the lymphatic system, supporting his views, very ably, by facts and arguments derived from embryology, and physiology generally, human and comparative. He states that it is decided without doubt, that during the earliest periods of fœtal life the lymph of the umbilical vesicle, derived by exosmose from the blood of the placenta, is designed for nutrition; the lymphatics are the vessels earliest formed, and have been seen full of this liquid; these vessels possess the greatest activity during fœtal life, which they possess even some time after birth, and all the organs peculiar to this system, as the thymus gland, the supra-renal capsules, the lymphatic glands, assume at this period their greatest development. In the lymphatic glands of the fœtus Haller discovered the fluid particularly designed for the elaboration of the chyle, which Assaline compared to the gastric juice. L. Parola then appeals to the early and rapid development of the liver in the fœtus, and its function of blood making; to the condition of the blood which in the earliest periods resembles lymph, and is gradually developed into blood; to the blood being first a serous fluid with but few corpuscles, and those in composition and constitution not the same as in after periods; and to the animal heat being three or four degrees lower as marked by the temperature of the fœtus. The plasma, and not the corpuscles, is exuded by the anastomosing placental vessels, and received through the umbilicus for the nourishment of the fœtus; and he argues a kind of antithesis, between the respiratory sanguineous system and the primitive organic assimilation, which continues until mature life. He adopts, from recent researches by Blondlot and others, the physiological doctrine of an intimate analogy between the liver and lungs, both in structure and function.

This analogy is well illustrated by Blondlot of Nancy thus: the liver is one of the most important visceral secreting organs; having a close analogy to the respiratory organs. The structure of the lungs in the fœtus and in inferior animals is nothing more than an undistended or merely tubular mass. Advancing in the scale, cells, in the progress of formation, become interspersed with the tubes, then acini are formed, and if the vesicles are not so small nor so contracted as those of the liver, it is because they are expanded

* Della Tuberculosi, 1849.

greatly by the air. When inflammation occurs to condense the tissue of the lung, the lung and liver present such an identity of structure that the name of hepatization has been adopted. If on the other hand the liver could be expanded by insufflation it would be a true lung. Again, the pulmonary artery carries the venous blood to the lungs as the vena portæ does to the liver. In both organs, these vessels transmit blood loaded with materials for elimination; the pulmonary veins correspond with the vena hepaticæ, and the bronchial arteries fulfil the office of nutrition, as the hepatic artery does. In form, structure, order and distribution, there is the closest analogy. In the bile, products resulting from the combustion of protein compounds are eliminated, the pyrogenetic or carbonaceous compounds; while the lungs separate the gaseous fluids and carbonic acid.

M. L. Parola fixes the origin and the seat of tuberculosis in the deficiency, or imperfection of hæmatosis in the lungs, and in respiration being imperfectly replaced by the liver. From hereditary weakness or accidental causes, the pulmonary function fails in proportion to the development of the frame, or the age of the individual, and the glandulo-hepatic system performs a preternatural supplementary function. This accounts for many of the phenomena of the predisposition. The diminished function of the lungs results, necessarily, in a diminished power of sustaining the animal temperature, and this increases as life advances and an increased quantity of chyle requires to be elaborated. Under these circumstances, external influences, inimical to life, become more intense in their effects, destroying or modyfying vital heat—hence engorged glands, vicious elaboration of chyle, and tuberculosis. The consequences of the defect of pulmonary development become more serious as life advances, particularly as aliment and exercise become more indispensable for the elaboration of vital heat and for nutrition. Hence tuberculosis manifests itself especially in cold and humid climates, in dark and badly ventilated places, particularly in those individuals who have an internal vicious organization; and on the contrary, the disease is much more easily cured in warm climates, because the function of respiration is less necessary to maintain the vital heat. He explains the derangement of the gastro-hepatic functions, by increased action of the liver to supply, in part, the respiratory functions.

E.—THE THEORY OF THE ESSENTIAL INFLAMMATORY NATURE OF TUBERCULOSIS.

It would appear superfluous, at this time of day, to confute the idea that tuberculosis is essentially an inflammatory disease; and yet, even since the pathological states of the blood have been more accurately investigated, this view has met with its advocates. The chemical constitution of the blood, described in the first chapter (p. 4), is a sufficient proof that this opinion is unfounded; and this is supported by the facts detailed in treating of the etiology (473). The absence, in the greater number of cases, of all signs of general inflammatory action, until a morbid deposit has established itself, so as to operate by mechanical irritation, is an additional proof. It is quite true, that after tubercle is formed, the ratio of fibrine in the blood rises above the average in healthy subjects, and the blood in other respects becomes inflammatory; and that this circumstance also happens occasionally, from the ordinary causes of an inflammatory state of the blood, before tubercle is deposited; but the proportion of fibrine in these cases is never so great as in the inflamed state of the blood in otherwise healthy subjects. So far from a tuberculous state of the blood being essentially inflammatory, a high degree of inflammation, such as occurs in pneumonia in robust subjects, for instance, is probably incompatible with the tuberculous transformation.

That the congestion of a part, in a tuberculous subject, be it inflammatory or not, is frequently attended with an effusion, and that tubercle may form in the effused fluid, there can be no doubt; but, in reference to the chemical constitution of tubercle (p. 143) and its microscopical elements (p. 119) as compared with those of inflammation, if in such an exudation there be not the true products of inflammation, but tubercle only, the occurrence of tubercle is a proof against, instead of for the exudation being inflammatory. This point, however, belongs rather to the etiology of local disease in tuberculous subjects, and particularly to the causes of tubercular deposit, than to the subject of the essential nature of the blood disease.

F.—THE THEORY OF DEBILITY OF THE ORGANIC NERVOUS POWER.

Dr. Copland regards some abnormal conditions of the "organic nervous influence in the first place, and the circulating fluids in the second place," as the "prime features of both the scrofu-

lous taint and of the more diseased grades of this taint, as manifested by external and internal tuberculosis." The direct operation of the causes of the disease is on the organic nervous system, and although the blood, sooner or later, and even from an early period of the action of the causes, must become affected, yet its modifications are always secondary to an affection of the nervous influence. The admitted causes of the disease, in Dr. Copland's system of pathology, are, in the main, those which have been stated in this treatise, but their operation, whether upon the digestive or assimilative functions, upon the vascular apparatus or blood, is primarily on the nervous influence; and although the "source of the morbid deposit may be traced to the state of the blood and to the exudation which takes place from the capillaries in the seat of lesion," yet the local determinations, and accordingly all the local tubercular diseases, are also primarily referrible to the state of the nervous influence of the part. (Dict. Pract. Med., part xv, p. 750, March 1852.)

This theory proceeds upon the assumption, that no external influence whatever acts primarily upon the blood, a theory which, since the days of Stahl, Hoffmann and Cullen, has always had its advocates. In a course of "Lectures on the Blood," published in the *Lancet* for 1839-40 (vol. ii, p. 548), we discussed the subject of the reciprocal influence of nerves and blood, and from the facts therein advanced, while we admitted the direct, and frequently powerful, influence of impressions through the nervous system upon the blood and the nutritive functions, we exposed the fallacy of the exclusive theory which we are now considering. The facts contained in that series of lectures, and those which have been developed in the subsequent progress of physiology and pathology have, as we think, satisfied the professional mind, that external agencies do act directly upon the blood, and that the nutritive functions, even in the highest orders of animals, are frequently, not only influenced, but wholly conducted, independently of a nervous system, according to the existing physiological acceptation of that term. With all due respect for Dr. Copland, and with much deference, we cannot help regarding it, as unphilosophical in the extreme to locate a disease in a *power*, or if it be merely held that the causes operate *through* the power, to make the essence of the *disease* to consist in the state of the powers, which can only be *plus* or *minus*; and if it be admitted that external influences at any time act

directly upon the blood and nutritive functions—that is to say—air in the lungs upon the blood as it passes through the lungs—poisons injected into the veins upon the blood of the whole system—foreign agents received into the alimentary canal also upon the blood—and in either case, that the affected blood influences the whole economy, the nervous system included, there is more evidence of tuberculosis being primarily an affection of the blood than, perhaps, of any other disease in the nosological catalogue.

G.—THE THEORY OF A POISON IN THE BLOOD.

Dr. Madden, of Torbay, is the most recent writer who advocates the doctrine, that tuberculosis depends upon a poison in the blood. Dr. Madden admits, that no poison has hitherto been detected, and he supports his doctrine wholly by analogical reasoning. He states that scrofula, with its highest and most formidable manifestation—phthisis—is as much a poison-disease as any with which we are acquainted. The analogies brought into requisition are chiefly the following :—1. A variety of specific effects follow the introduction of certain substances into the blood, so as to leave no doubt, that the substances, mercury, lead, spurred rye, for instance, are the causes of the effects ; the symptoms and pathology of tuberculous disease are analogous to these effects, and may therefore be attributed to the introduction of a poison into the blood. 2. The general pathology of diseases, acknowledgedly depending upon a poison in the blood, is closely analogous to that of tubercular diseases ; in most diseases of this nature, as, for instance, fever in its various forms, pyohæmia, gout and rheumatism, syphilis or glanders, the effects of the poison, often widely diffused over the system, shew a predominant tendency towards certain parts, as the eye, the bones, the joints, the skin, the lungs, the larynx and air passages, the liver, the spleen, the kidneys, the brain, the heart, or to the serous, the mucous or the areolar tissues ; tuberculosis exhibits an analogous tendency to local disease, as illustrated in scrofulous ophthalmia, ulcerations of the larynx and trachea, glandular swellings and subcutaneous abscesses, caries and articular disease, affections within the cranium, ulcerations of the intestines, fatty states of the liver, disease of the kidneys, or disease of the lungs. 3. The general symptoms of tuberculous diseases are analogous to those of poisoning in the above cases ; as, for instance—fever, which is almost universally present, though in varying degrees and

of diversified character; emaciation; derangement of the digestive functions; pains in the limbs; perversion of the structure and functions of the skin; a small pulse; debility; an unnatural character of the secretions and excretions. Dr. Madden states—there is a close analogy between the fever produced by the paludal poison and the fever which attends scrofula and phthisis. 4. The "lardaceous liver" observed in patients wasted by tuberculosis, is precisely analogous to, if not identical with, the change in that organ noticed by Dr. Graves in those whose health is broken down under the influence of the double poison—mercury and the poison of syphilis. 5. The morbid product in tuberculous diseases is everywhere the same, and tubercle is often coetaneously deposited in many parts of the body. 6. The analogous signs of the elimination of a poison, which are manifested both in cases of artificial poisoning and in diseases undoubtedly arising from poison, as well as in tubercular diseases. 7. A period of latency which exists for most poisons, though with great differences as to extent, an analogous period of latency existing in tuberculous affections, on the principle that its cause is in the blood.

To form an opinion of this doctrine of a poison in the blood, we must consider what is meant by the word *poison*. Poisons acting through the blood are — 1. Substances accumulated in the blood from non-elimination, as in the case of urea; having a tendency to deposit themselves in particular structures, or to pass out of the body by particular secretions, and producing corresponding symptoms. We have not the slightest proof of the existence of any foreign agent or materies tuberculi analogous to this. 2. Substances derived from without, which act upon the animal economy in proportion to the quantity introduced, having no tendency whatever to reproduce themselves, but, on the contrary, having a constant tendency towards elimination from the moment they are introduced. 3. Substances derived from without, having a tendency to reproduce themselves, the specific causes of special trains of symptoms peculiar to each, and producing all their effects however small the quantity introduced; propagating themselves until the whole mass of blood has undergone a change, the effects proportionably increasing until this has taken place, when a crisis occurs and the poison is expelled or destroyed. Nothing analogous to this occurs in tuberculosis, regarded as a disease of the blood, and viewed in its essential state apart from the

local diseases, and the hectic fever which most frequently supervene. Tuberculosis may exist and tubercle may be deposited, even in vital organs, without the manifestation of any of those disturbances in the system which result from poisons. The morbid product has remained in the lymphatic, mesenteric, or bronchial glands, and even in the lungs, for years without producing poisonous effects.

The circumstances brought forward by Dr. Madden support the view taken in this work, that tuberculosis is essentially a disease of the blood, and many of them are strongly in favour of the opinion, that during the progress of local diseases, in tuberculous constitutions, and in particular, those which result from the deposit of tubercle, a poisoned condition of the blood supervenes. This view might be taken of the hectic fever; but this fever is not an essential part of the original constitutional disease; nor is it embraced in the subject here treated of. Confining our view to the original disease, we see clearly, that among the numerous analogies referred to, there is not one favorable to the idea, that the morbid condition of the blood is produced by a poison, although they are all consistent with the theory of an abnormal constitution of the nutritive plasma of the blood, of the existence of which we have irrefragable proofs, not from analogy alone, but from direct observation.

In treating a point of this nature, it is very important that we do not fall into a mere verbal dispute. If, for the sake of illustration, it were proved, that air stagnating in the chest produces a modification of the protein compound of the blood, by a mere change of the proportions and arrangement of its normal elements, but such a modification as would interfere with the development and nutrition of cells and the nourishment of the organic tissues, and Dr. Madden includes such a modification of a proximate constituent of the animal fluids or solids in his definition of the word poison, in that case, a difference of opinion would exist only on the propriety of the application of the term; but it is to be apprehended that the word "poison" is employed, in the work before us, more in accordance with its general acceptation, and that it applies to a substance totally foreign in its nature, to the essential proximate elements of the nutritive fluids or organic structures.

II.—THE THEORY OF MAL-NUTRITION.

(*a*) *A vitiation of the blood in the process of respiration.*—M. Baudelocque, proceeding upon the principle, that the sole cause of

scrofula is the respiration of an atmosphere not sufficiently renewed, maintains that this vitiated atmosphere vitiates the blood, which must produce injurious effects over the whole economy. The disease is accordingly one of imperfect nutrition; the materials of the secretions and of nutrition participate in the bad qualities of the blood, and all the tissues are developed or repaired with elements of a vitiated nature. Owing to the incessant change of composition and decomposition over the whole body, its different parts are soon composed entirely of these elements, and while such changes are proceeding, we have the scrofulous constitution. The cause persisting, and modifying more completely both solids and fluids, renders their condition ultimately incompatible with health, and scrofula is developed. The whole of the tissues may become, successively, diseased, all the secretions more and more altered, until the partial destruction of the organs gradually entails their total destruction and death.* The point of departure of the disease is the fluids; but the solids become involved and react upon the fluids, and ultimately both in the solids and fluids, we meet with the cause as well as the effect of the malady.

(*b*) *A Disturbance of the Healthy relations of the Oily and Albuminous principles and an excess of the latter.*—Dr. Hughes Bennett has given this definition of the essential nature of tuberculosis.† He states, that the union of oily and albuminous principles is essential to nutrition, and that oil is as necessary to cell growth and the formation of the tissues as albumen, since there is no elementary cell into which both oil and albumen do not enter. He regards the elementary granules of histologists as minute oily particles precipitated from the blastema, and separately, or united with other substances, constituting *nucleoli;* the latter being composed of oil surrounded by an albuminous membrane. Under the vital power, these granules and nucleoli are developed into cells and transformed into the various tissues. The healthy relations of these chemical and physiological principles may be disturbed, so that some individuals have a tendency to morbid obesity, and others to leanness. A certain degree of inactivity, for instance, while the elements necessary for the formation of fat are amply supplied, induces a fatty state of the tissues, or these are transformed into fat, as in the case of rendering the livers of geese fatty.

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* Études sur les Causes, &c., de la Maladie Scrofuleuse. 1834. p. 182.

† Monthly Journal of Medical Science. September, 1847. p. 166.

In man, also, when fluids abounding in carbon are continually drank, the liver frequently becomes fatty. In the consumptive, when the action of the lungs has for some time been diminished, particularly where little exercise is taken and the diet is rich, oil frequently accumulates in the hepatic cells. There are also diseases which depend on an excess of the albuminous principle, many tissues, for instance, being liable to be converted into a dense albuminous mass; all tubercular diseases are of this class; the chemical reactions of tubercle indicate an excess of albuminous and a deficiency of oily principles, and tubercles occur, especially in organs destitute of fat. In support of this doctrine, it has been shewn by experiment, that globules of oil diffused artificially through an albuminous solution, will be followed by a condensation of the albumen round each separate oil globule, enveloping it with a membranous film, and cementing it with something much like a true cell; and in the products of inflammation both oil and albumen enter into the formation of the pus globule.

(*c*) *A Retrograde Morphology.*—Dr. Addison has lately promulgated a novel and very remarkable theory.* His idea is, that a disposition exists in the nutritive processes to assume a "retrograde morphology," and that this may be received as a general expression of the tuberculous constitution. Availing himself of the known phenomena of vegetable morphology and of the development of the human embryo, and appealing to the cell theory of growth, the lowest type of all organized structures being found in "non-coherent" cells, the next in cellular tissues, the next in fibres and cells conjoined, and the highest in dense structures; Dr. Addison maintains, that in tuberculous diseases, these metamorphoses of tissue take place, not only imperfectly, but if the defect exist during the ordinary process of growth, they are exhibited in a retrograde order. The low vitality of the blood, and the diminished formative energy of the cells and tissues, are exhibited in the defect of development of the healthy textures, and in the slowly formed granulations and tissues during the imflammatory process; and the retrocession from the higher form of morphological manifestation to the lower forms, in the fatty degenerations and the vegetative characters of the granulations, cicatrices and fungosities, and in the chemical and structural character of tubercle itself. Scrofula

* On Healthy and Diseased Structures and the true principles of Treatment for the Cure of Diseases, &c. 1849.

is thus essentially a retrograde metamorphosis of the tissues, in which cells of a low type are substituted for coherent cells and fibres, or even for cartilages, bones, and other essential structures of the human body.

This retrograde morphology may be the result of an original taint of constitution, or the taint may be acquired from the presence of certain external conditions, and when acquired it may be transmitted to offspring and may be lost again at a future period.

Dr. Addison's theory obviously presupposes some antecedent condition in which lies the essence of the disease.

Having thus placed before the reader most of the theories now in vogue relating to this disease, which may be compared with those that preceded them, contained in the preliminary abstract, many interesting considerations suggest themselves. The definitions and descriptions are necessarily much abridged, but they will generally be found to embrace the essential points of the doctrines taught, and be sufficiently in detail to answer every useful purpose.

In the first place, it may be remarked, that although the abstract truth of many of the views which these theories embrace may undoubtedly be admitted, yet, even where this is the case, the definitions are by far too limited to be received as general expressions of the disease, since they consist of one or two characters only, which are by no means the most essential; as respects others, they are vague, or purely hypothetical, or absolutely untrue. It will be observed also, that in several instances, two or more totally different theories may be admitted as true without being inconsistent with each other, a sure proof of inadequacy, and that a more comprehensive definition is required.

We will refer but to one example. Dr. Addison's view of a retrograde morphology might be admitted. The manifest defects of structure in the various tissues, resulting from defective cell-growth, may be regarded as, and undoubtedly is, a retrogradation in the organic processes, but even if we were to adopt Dr. Addison's view in full, it is only an expression by which the phenomena are represented, and it embraces no explanation whatever; it is not incompatible with M. Shultz's or Mr. Simon's views. To retrogradation of structure, as a law, there is this fatal objection,

the defective cell-growth in tuberculosis is not a uniform or constant retrogradation from the type of a higher to that of a lower species; it is rather an aberration. Thus the tubercle corpuscle, regarded either as a defective cell or nucleus, does not approach in structure to the cell of any lower species of animal or vegetable. Neither is the mal-organization of the frontal bone, so common an occurrence in the tuberculous predisposition, a retrogradation in type to the frontal bone, for instance, in the ape. It is simply an irregular construction of the bone, indicating that the material of which it is formed was originally defective, and that during its formation the ordinary laws of organization were disturbed in consequence. At least I submit this view of the case.

It is interesting to compare the views entertained of the nature of this disease by Drs. Christopher Bennett, Richard Morton, Parr, Baudelocque, Buffalini, Canstatt, Madden, Mr. Simon, Dr. Hughes Bennett, and Dr. Addison. They all involve the idea of a morbid state of the plasma, succus nutritivus, or liquor sanguinis, of the more modern pathologists, produced by one or more of the agencies concerned in the elaboration of the vital fluid; that is to say, a morbid condition of the fluid upon which the whole of the organized structures are dependent for the materials required in their development, growth and reparation. As explanations of the real nature of the disease, there is not one that reaches the point. Even if we could admit the most simple, viz., "a poison in the blood," we are equally ignorant of the nature of the poison, of the particular constituents of the blood upon which it acts, and of the nature of its action or the changes produced—all remain to be discovered.

The theories of Buffalini, Canstatt, Mr. Simon and Dr. Hughes Bennett, undoubtedly approximate more closely to the real question of the essential nature of the disease than either of the others, ancient or modern. There is also no doubt that the whole, however theoretical, and however in some points they may differ from each other, are founded upon the facts of modern science. After all the attention I have been able to bestow upon the subject, I have no hesitation in declaring my opinion, that Dr. Hughes Bennett has advanced the farthest in this investigation; and I believe that the pursuit of the enquiry in the direction indicated by these pathologists, and especially by the latter, will ultimately lead us to a knowledge both of the modus operandi of the causes, and of the essential nature of the disease.

At present, however, not only the essential nature of the tuberculous state of the blood, of the mal-nutrition of tuberculosis, and of tubercle itself, is *unknown*, but many of the most plausible views that have been promulgated, are unsupported by experiment and general observation; some of the most available facts have not been sufficiently verified to be allowed to pass current; and none of the above theories have been generally accepted; it would therefore be folly to enter into their minutiæ in the present treatise, or to engage in any lengthened theoretical discussion; we shall accordingly terminate this section, by setting forth a few of the considerations belonging to the subject, which strike us, as the most important.

Although we dissent from Dr. Madden's view that tuberculosis depends upon a "poison" in the blood, the existence of a definite materies morbi, is a legitimate inference. As an independent constituent it has never been detected. Dr. Prout's researches led him to conclude that a modified albumen, which he designates "incipient albumen," may be formed in the stomach, and if this doctrine be admissible, the probability must also be admitted, of the existence of abnormal compounds of the chemical elements which constitute the oil, albumen, fibrine, and other complex constituents of the blood. Chemistry cannot at present determine all the varieties and grades of the proteine compounds, but, if we consider, that one or two equivalents of carbon, azote, or sulphur, may constitute the whole difference between an assimilative and non-assimilative compound, the existence of some modification of the proteiniform or oleaginous compounds of the blood in tuberculosis, is rendered highly probable.

This is one point; but it is distinct from the question, whether tubercle is formed originally in the blood within the vessels, or in the extra-vascular blastema. When the facts are duly considered, and viewed in relation to the physiology of the blood, the mind cannot escape from the reflection, that it is quite possible the tubercular deposit may be formed in the blood, and merely separated, during the transit of that fluid through the capillaries of those structures, in which it is ultimately aggregated. It is now admitted that urea is merely eliminated and not formed by the kidneys, and yet the quantity of urea in the healthy blood, at any one time, is so minute that it has almost always eluded detection. If this be the case with urea, possessed of such distinctive charac-

ters, how much more certainly would tubercle elude detection? so nearly allied as it is, in its qualities, to the normal proteiniform and oleaginous constituents of the blood. Appealing again to the physiological law, that a foreign substance formed in the blood, or taken up by that fluid, is frequently eliminated by one, and generally by at most a few organs, as fast as it is formed or imbibed, we see the reason why, if one or few organs assume this task for tubercle, we have not a universal deposit of that substance, and very rarely a deposit in many organs at once. With these facts and considerations before us, we are not justified, in the present state of science, in the total rejection of that view, which regards tubercle as being formed primarily in the blood itself.

However this may be, the analogies which subsist between 1, the mal-nutrition of structures having cells for their basis, and the deficiency, and probable mal-nutrition, of the red corpuscles of the blood in the tuberculous predisposition, as described in the first chapter,—2, the malformed cells and corpuscles, and the educts and products of tuberculous blood as described in the second and third chapters,—render it certain, not only that the blastema, or organizable fluid separated from the liquor sanguinis, and exuded through the blood-vessels into the interstices of the various tissues, has undergone some change in its component parts, but that tubercle in its aggregate form developes itself in this fluid. This fluid is the site of the processes of absorption and deposition; however tuberculous it may be, so long as the balance between these processes is maintained, although the 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 relations 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 fibre. Hence, instead of contributing to the formation and nutrition of fibres 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 apt to accumulate in masses than the con-

stituents of a healthy blastema. It thus becomes a foreign material subject to chymical and physical changes.

The inference must not be drawn, that either the liquor sanguinis, or the blastema as separated from it, however tuberculous, is wholly so; facts clearly shew that it is not. That the nutritive fluid, out of which tubercle is formed, is capable at the same time of producing other substances, both natural and morbid, has been proved in the pathological anatomy (p. 207,) from Dr. Carswell. Take one of the proximate principles of the blood and blastema, the protein, for example, even that is not converted or damaged as a whole, but perfect protein is combined or blended with some heterologous or abnormal combination of the elements of which it is composed; this heterologous constituent becoming the pabulum or origin of tubercle, or interfering with the regular process of fibrillation, cell development, and nutrition generally, and producing those anomalies in the growth and development of the body, and that degradation of pus and other morbid products, which have been described.

This consideration is of the highest importance. If the liquor sanguinis were wholly diseased, the existence of tuberculosis would be incompatible with that of any other blood disease; which is contrary to the fact. Any morbid influence or agent, electrical, magnetic, poisonous—animal, vegetable or mineral,—capable of destroying the normal constitution of the whole fibrine of the blood, or its analogue in the liquor sanguinis as the latter circulates in the vessels, would, if instantaneous in its effects, instantaneously destroy life; and if more gradual, it would destroy life long before the blood lost its coagulating power, and accordingly long before the whole of the fibrine was destroyed.

We thus obtain a glimmer of light reflected upon the abstruse problem before us. Let us search a little further. We have already objected to Mr. Simon's localization of the disease in the lymph, but there is a conclusion which this gentleman has arrived at, as it appears to us, of immense importance, viz., that the morbid element takes its rise in blood of recent formation; "the young blood," as Mr. Simon expresses it. Physiological considerations assure us that the ratio of new to old blood is greatest in early life, and progressively decreases as age advances, and this view affords an explanation of some of the most prominent but otherwise inexplicable phenomena of the disease.

Although, from the nature of the tissues involved in the malnutrition, and the chemical constitution of tubercle, there can be no doubt that the proteiniform element of the blood is involved in the primary and essential defect, there are facts to shew that it is not this element alone which is concerned. The effects of cod-liver oil in arresting the emaciation and other symptoms direct attention to the oily principle. That the fatty element of organized bodies has some essential relation to the disease is clearly indicated. It was observed by many of the earlier writers that the fat of tuberculous subjects exhibits peculiarities in its sensible qualities; fat is one of the essential elements of cells, and a defective nutrition of cells is one of the most prominent features of tuberculosis; so also fat is one of the component parts of tubercle, but it is fat in the spurious form of cholesterine (p. 146—153)—a form unsuited to cell nutrition; and lastly, the fatty matter which accumulates in the liver of tuberculous subjects, and probably in other organs, differs from ordinary fat (p. 296). Cholesterine and caseine in tubercle to a certain extent replace normal fat and albumen in the blood and blastema, and Dr. Hughes Bennett's view, that the malnutrition takes it rise in some defect in these two principles, or in the relations which ought to subsist between them, is fully borne out.

A diminution of the proportion of red corpuscles, has been shewn to be one of the earliest results of the depraved constitution of the liquor sanguinis, and we may now say, hypothetically, of a portion of its proteiniform and oleaginous principles. Viewing the blood corpuscles, according to Baron Liebig's theory, as the conveyers of oxygen to all parts of the system, and the development of uric acid as an early stage of the destructive oxygenation of the tissues, which is replaced by urea when the oxidation is more complete, we should predicate for tuberculosis, an increased excretion of uric acid in proportion to the urea of the urine. From E. Becquerel's researches, there is reason to believe, that as the disease advances, such is the case, since he found in the earlier stage of tuberculosis pulmonalis, the ratio of uric acid to urea as 1 : 7·33, and in a more advanced stage as 1 : 3; the proportion in health being as 1 : 31·48; but in uncomplicated tuberculosis, before the proportion of the corpuscles has greatly diminished, we have no evidence of this diminished oxidation, in fact it does not occur. Corresponding with the loss of weight, and the

smaller quantity of muscular and other convertible tissues, there is a diminished amount of animal matter in the urine (pp. 46, 83), but its oxidation appears at first to be perfect. As the proportion of corpuscles diminishes, and particularly if febrile action supervene, the oxidation becomes less perfect, and the ratio of the uric acid to the urea increases.*

Although a study of the causes has brought into prominent relief a defect in the true process of respiration, and we have seen that, as the disease advances, there is evidence of a diminished oxidation of the rapidly decomposing tissues, the greater number of the facts are explained on the theory of hyper-oxidation as essentially related to the proximate cause of the blood disease. Admitting a diminished respiration and a retarded circulation of the blood in the lungs, it is easy to conceive that some of the constituents of the liquor sanguinis, as portions of the proteiniform or oleaginous principles, which retarded in their course, instead of passing with their usual rapidity through the lungs, may be chemically damaged by the action of oxygen, and their nutritive properties modified; even as a metal becomes more highly oxidized when cast into a furnace than when passed through a fire. Supposing a portion of the plastic constituents of the liquor sanguinis thus directly rendered unfit for nutrition, the circumstance would be manifested, in the first place, by the formation of fewer corpuscles; and subsequently, by the mal-nutrition of the tissues; hyper-oxidation of the liquor sanguinis would thus become the cause of a diminished oxidation in the general system, by lessening the means of transit; for it has to be borne in mind, that in the physiological state, the oxidation of carbon to form carbonic acid is not effected in the lungs, but in all the more remote parts, by oxygen conveyed by the blood for the purpose.

Many of the anomalies in the history of the disease may be explained by this theory, and it is consistent with a very large proportion of the facts. None appear to be more amenable to it than those which belong to the etiology. A residence in close, damp situations produces the disease, by limiting the action of the respiratory powers, and increasing the direct oxidation of the plastic constituents of the liquor sanguinis; a residence in localities consi-

* Lancet, 1842-43, vol. ii, pp. 82, 206, 222; where this subject is discussed, in communications from the author of the present treatise, and the reviewer of Baron Liebig's Animal Physiology in the British and Foreign Medical Review.

derably elevated above the level of the sea, cures the incipient disease, by giving full play to the respiratory powers, and diminishing or preventing the direct abnormal oxidation of the nutrient constituents of the liquor sanguinis; a poor diet is the most powerful of the ancillary causes, by contributing to diminish the force of the pulmonary circulation, by limiting the quantity of oxidizable material brought under the influence of the comparatively stagnant air resident in the chest, and thereby promoting the hyper-oxidation of that which the blood contains; a good diet, acting conversely, diminishes the hyper-oxidizing effect of the oxygen in the lungs; a venous or dearterialized state of the blood becomes antagonistic of tuberculosis, by preventing hyper-oxidation of the liquor sanguinis, since its corpuscles appropriate the oxygen too completely to allow of that effect. This view of the case is quite consistent with all the essential symptoms of uncomplicated tuberculosis. (p. 64.)

The facts relating to the emaciation of tuberculosis have been stated (p. 65), and it is here an important consideration, how far the gradual waste depends upon a failure of the assimilating processes, or upon a more rapid destruction and absorption of the living tissue; upon a deficiency of supply or an excess of waste; or whether it depends upon both these pathological states. We are not in a condition to determine which is primarily at fault, even as respects the gradual diminution of the blood corpuscles. The state of the urine would seem to indicate, according to Liebig's hypothesis, that the disintegrating processes are not primarily in excess, since the oxygen introduced into the system, although probably less than in health, is still sufficient to change the lithic acid into urea. The fact, that in acute diseases, where a rapid destruction of the solids of the body unquestionably takes place, the progress of the emaciation is much more rapid, and where this increased absorption of tissue occurs, the disease terminates quickly, either in the death of the individual or in the restoration of the balance between absorption and assimilation; and as recovery advances, an increase of the latter in the shape of healthy nutrition; seems also to indicate, that in tuberculosis, the emaciation does not depend primarily upon an increase of waste. Bourchardat, from the study of those cases of diabetes which terminate in phthisis, arrived at a similar inference; here, according to this writer, the functions of the stomach are perverted, a mor-

bidly rapid solution of feculent substances takes place, glucose appears in the blood, the function of the kidney takes on an increased activity, the transformations of the blood are modified, and it ceases to form nutritive materials; hence the emaciation. There is one other circumstance bearing on the subject, we have reason to believe, that in tuberculosis, less carbonic acid is exhaled from the lungs than in health (p. 97); whereas in acute diseases, where a rapid absorption of the tissues occurs, as a general rule, the exhalation of this gas is increased.

These considerations are, however, by no means conclusive that the waste of the tissues is not increased in tuberculosis; if they were, it would be less appropriately named a *consumption;* it would rather be a disease of *inanition;* but we believe the truth to be, that it is both. At the same time, the facts relating to the blood and urine, those just detailed, and those which relate to the defective nutrition of the original tissues and cells, lead to the conclusion that the increased waste is secondary to the mal-nutrition, and that in the earlier stages of the disease it has a much smaller share in the effect than subsequently. The ratio of the destructive to the assimilating process increases greatly when local affections supervene, and febrile action is set up. The more rapid emaciation then sometimes commences suddenly and coetaneously with the febricula of tuberculosis (p. 105), or the hectic fever of phthisis, and there is observed a deficient oxidation of the effete materials, in the increased ratio of the uric acid to the urea in the urine, and in the tendency to deposit fat in particular organs of elimination.

A more strictly chemical view has been taken. It has been held that the blood does not assimilate a sufficient quantity of the materials for combustion, hence the reserve fat of the tissues is first absorbed and consumed; and when this is exhausted, the tissues themselves, and especially the muscular fibre, are attacked; but this view is not consistent with the fact, that tuberculous subjects will eat and perfectly digest a full quantity of nutriment, with the usual proportion of the materials for combustion, and at the same time the emaciation and the deposit of tubercle will proceed rapidly. The facts rather indicate that the materials for combustion received into the blood are not sufficiently consumed, owing to the deficient amount of oxygen conveyed with them to the systemic capillaries, and throughout the greater circulation. This view of the case is consistent with M. Guillot's discovery

(p. 153); and the facts relating to the accumulation of fat in particular organs, seem to indicate, that a portion of the fatty principle in the blood neither being consumed nor employed in nutrition, but probably, like the proteiniform element, modified, accumulates, especially in the liver and lungs, the organs for the elimination of the products of the eremacausis of fatty substances; the fat (cholesterine?) thus accumulated, being in a lower state of oxidation than ordinary fat, if a universal fact would support this view.

Finally:—We thus trace this fatal disease to a primary error or defect in the blood-making process. Vitiated air, or air stagnating or insufficiently renewed within the chest, and probably other anti-hygienic influences—as a vitiated or defective diet—acting singly, coetaneously, or as respects each other ancillary, produces, slowly under ordinary circumstances, but occasionally with great rapidity, some unknown change in a portion of the proteiniform principle of recently formed liquor sanguinis; this change may consist in hyper-oxidation, but whether so or not, it deteriorates its properties, rendering it, more or less or altogether, unsuitable as a material for organization. At the same time the oily principle of nutrition, circulating with a diminished number of red corpuscles, is in part converted into a fatty substance of a lower degree of oxidation. These modified proteiniform and oleaginous principles are exuded in the blastema, and are either employed in the assimilating processes, deranging the nutrition of many of the organic structures, and giving the tuberculous or scrofulous character to various pathological processes; or, in the more advanced stage of the morbid process, they are deposited in particular tissues and accumulate, generally in the form of tubercle, but sometimes both as tubercle and morbid fat; substances, for the most part, incapable of organization.

In the present state of pathological science, confining ourselves to its legitimate object, the study of *phenomena*, apart from any metaphysical views of final causes relating to the *powers* of nature, this appears to us the most accurate definition that can be given of the essential nature of tuberculosis.

SECTION II.

THE DIAGNOSIS.

To determine the existence of tuberculosis previous to the deposit of tubercle in any tissue or organ, is a point of practice of immense

importance to the welfare of the patient—equal to any that can present itself to the attention of the practitioner. In many cases, with a knowledge of the antecedent and present history of the patient, and a correct estimate of the causes of the disease, the diagnosis may be made, if not with certainty, still with a high degree of probability; in other cases, with all this knowledge at our command, it is a problem of the greatest difficulty. It involves the determination, at any period of life, of the existence or non-existence of a tuberculous condition of the blood—of that quality which produces the mal-nutrition of the tissues, so fully described (p. 20), and which keeps the individual in continual risk of the exudation into the intimate structure of the vital organs, of an imperfectly organizable blastema. Unfortunately, microscopical anatomy and chemistry afford us little assistance; there is at present no known sign of diagnostic value by which tuberculous blood can be distinguished from that which is non-tuberculous. In the absence of this demonstrative evidence, we can only fall back upon the history of the case, and the existing signs and symptoms. There are none of the latter, taken separately, which do not occur in other diseases. At the same time, there are certain combinations, which render the existence of tuberculosis highly probable, if they do not reduce it to a certainty, and that certainty may not infrequently be secured by attention to the family history, the occupations and habits of life of the patient, and the diseases to which he has been previously subjected.

The diagnosis of a tuberculous state of the blood, when it is affected to the degree of modifying the nutritive processes and the morphology of the living structures, is still a very difficult matter. If a large number of individuals be examined by an experienced observer, he may divide them, in reference to this question, into three groups;—1, Those who present the physiognomy and general physiological character of perfect health, or of diseases other than tuberculosis, as affections of the heart;—2, Those who present unequivocal characteristics of the tuberculous constitution;—3, Those which are doubtful. He will accomplish this from his knowledge of the peculiarities of the tuberculous predisposition, detailed in the first chapter of this work, and his experience of the different groupings of those peculiarities which have presented themselves to his observation. This process will, however, leave a very large proportion examined in the third or

doubtful group; and there can be no doubt that many of those would prove, on following out their history, to be tuberculous. Under these circumstances, the diagnosis may frequently be determined, in any particular case, by an investigation of the state of health or disease of the family, and of the individual, and especially, as respects the diseases with which the latter may have been affected —their origin, progress, duration, and termination. With these aids, we can very frequently arrive at a correct opinion as to the existence or non-existence of a tuberculous state of the blood, even at the commencement of any affection of which the intensity or course is likely to be determined, by the previous healthy or unhealthy condition of the blood; as, for instance, an inflammatory affection of a large joint, either from an injury or cold. When local affections occur, by observing their symptoms and progress, and the effects of remedies administered, the diagnosis is very quickly rendered much more simple and easy. Among the most important signs, may be especially noted—a chronic character of local affections which, occurring from similar causes in healthy constitutions, would prove acute; also a tendency to an interruption or disturbance in the physiological actions of different organs, or of the whole frame, from causes so slight, that they would not affect the individual whose blood is healthy; also a tendency to a multiplication of local affections from inadequate causes. Thus it is, that we are very soon enabled to determine that a particular affection is "scrofulous," which is equivalent to the diagnosis of a tuberculous state of the blood. The diagnosis in this stage, which is not one of active blood disease, thus turns upon the constitutional history of the patient and the pathological anatomy of "scrofulous" affections, to which may be added, attention to the causes, since the effects of external agents, whether the causes of disease or their remedies, are alike modified by this state of the blood.

In forming our diagnosis, where the signs and symptoms of tuberculosis as an active disease of the blood exist, be they clear or equivocal, we are determining the question whether the individual is or is not immediately threatened with the deposit of tubercle, and, accordingly, with hydrocephalus, phthisis, tabes mesenterica, and other fatal tubercular diseases.

The diseases and morbid conditions of the blood from which tuberculosis requires to be distinguished are, especially, anæmia,

atrophy, chlorosis, the debility resulting from rapid growth, or the effects of hæmorrhage, excessive discharges, or sexual vices and excesses, and from cancer particularly of the stomach or uterus while the disease is in its early stage, from slight cases of scurvy, and from the remittent fever of infants. When either of these morbid conditions are well marked, the diagnosis is not difficult; but in the minuter shades closer attention to the history and symptoms is necessary. The chloro-anæmia of young females is sometimes with difficulty distinguished, since it presents many of the symptoms of tuberculosis, and an error of diagnosis, wherein pallor, debility, relaxation of muscle and palpitation, are attributed to chlorosis alone, when they depend upon tuberculosis, is not infrequent—(Fournet).

In many of these cases, where some of the more prominent of the signs and symptoms of tuberculosis present themselves, notwithstanding the most careful investigation of the history of the case, and the most minute observation of the existing state of the patient, it is impossible to arrive at any degree of certainty as to the existence or not of a tuberculous state of the blood and impending tuberculization of the organs. This is especially the case in children. Under such circumstances our judgment must be in abeyance.

A most important element in forming a correct diagnosis, when the *symptoms of tuberculosis* (p. 64) set in, is to observe their association and their successive development; after which their antecedents, and the *causes* by which the illness has been induced, demand attention.

If a patient present a history totally free from the suspicion of hereditary transmission (pp. 373—6), and of the congenital origin of the disease (p. 389), if free from the signs of the tuberculous predisposition indicative of the existence of a tuberculous state of the blood—either those of more recent origin, as the malnutrition and deranged functions of the cutaneous and mucous structures, or those of antecedent date, as the more permanent irregularities of the bony skeleton (pp. 20—26), and if the operation of the anti-hygienic influences most intimately concerned in the production of the disease have not preceded the illness, then, notwithstanding the existence of some of the most prominent diagnostic signs, as, for instance, the debility and steadily progressing emaciation, the presumption is strongly against the existence

of this disease; on the complete investigation of such a case it will generally be found that some other disease exists to account for the symptoms.

Amongst the circumstances which afford the presumption of the existence of the disease, the *hereditary* right to it stands foremost; but even this admits of very great qualifications. The presumption is stronger if both parents are tuberculous than one only, in the direct than in the collateral line, and in some degree in proportion to the intensity of the disease in the progenitor, and other circumstances (p. 383). Next in importance to the pre-existence of the disease in one or both parents, may be placed the existence of the signs of the *tuberculous predisposition* in the individual. These, again, may be more or less numerous, and more or less slightly or strongly marked, according to which they have a proportionate value. The hereditary tendency co-existing with a well marked tuberculous constitution, establishes a diagnostic conclusion when the symptoms of the disease supervene. But the hereditary tendency has a very high value where the predisposition is not well marked, and even where it is not observable. Some of the most acute cases result from the rapid transformation of the blood into a tuberculous state, and the general deposit of tubercle, owing to the simultaneous operation of the inducing causes of the general disease and the exciting causes of local disease, in individuals hereditarily predisposed, but previously in good health, and with few or none of the signs of the tuberculous constitution. Next in the order of importance in forming a diagnosis, is the fact of the continuous operation of those *anti-hygienic influences* which have been described as the most efficient of the inducing causes. If an individual, with the history of an hereditary tendency, and signs of the tuberculous predisposition, continuously subject to the air of a small chamber, or close workshop, without sufficient exercise, and also subject to the depressing passions, exhibits the prominent signs and symptoms, we may be tolerably certain of the existence of the disease. It must, however, not be forgotten, that anti-hygienic influences alone may occasion the disease; it is only that the co-existence of the other circumstances strengthens the diagnosis.

In some of the cases above referred to, which have very appropriately been designated cases of "*acute* tuberculosis," the symptoms commence in an aggravated and violent form without any previous signs of disease, either in the blood or in the brain, chest, abdomen,

limbs, or any part whatever; the rapid and intense tuberculization of the blood appears to destroy its vitality, and all the effects upon the whole economy that would follow from direct poisoning of the blood, by a malignant or destructive poison, are produced (p. 265). In these cases, the general symptoms precede the deposit of tubercle, but this follows very rapidly; tubercles occur in great numbers, frequently in several organs, and we have tuberculosis running through all its phases in a very short time, and resembling a malignant fever, complicated with the most destructive pneumonic attack and disorganization of the lungs. These cases have often been mistaken for attacks of pneumonia, and the fatal results recorded as such, both in infants and adults, without any regard to the tuberculous affection of the blood.

As well remarked by Fournet (l. c., p. 743), such cases prove incontestibly, that the production of a tuberculous state of the blood is not a consequence of the deposit of tubercle, nor of any local effects of tubercle developed in the lungs or elsewhere, inflammatory or otherwise. The closest observation proves, that the general symptoms are independent of the existence of tubercles, and that they are the result of that disturbance in the molecular actions of the blood, which attends its rapid transformation into a tuberculous state.

The existence of one or more of those *predisposing causes* which have been so fully described (p. 395), has also to be considered in forming our diagnosis. The female sex and the lymphatic temperature have a very slight, but the age of the individual a very great influence; and the antecedent occurrence of those diseases which deteriorate the vital qualities of the whole mass of blood, drain the circulating vessels, and lead to their rapid repletion with a large quantity of new blood, are equally important. The fact that an individual, with an hereditary tendency and a tuberculous constitution, has recently been the subject of an attack of measles, bronchitis, pneumonia or hæmorrhage, renders more certain the existence of tuberculosis on the occurrence of symptoms; and the diagnosis is greatly strengthened, if, at the period when the signs of convalescence may reasonably be expected, the symptoms of tuberculosis supervene; and the certainty of the nature of the disease is rendered still greater, if the patient be surrounded with those antihygienic influences which directly or indirectly tend to its production.

After these more general considerations, certain partial *peculiari-*

ties of the *conformation of the body*, and in particular the vicious conformation of the *chest* or *head*, attain very great importance in the diagnosis, even of the constitutional disease. It is true that these signs have a special value as indicating a predisposition, not to tuberculosis merely, but to tuberculosis pulmonalis or cerebri; but their relation to the blood disease must not be overlooked. When physical signs of the deposit of tubercle in the lungs, the first stage of phthisis, are superadded to the signs of the constitutional disease, the diagnosis of the latter is doubtless rendered more certain; but an examination of the chest ought in no case to be omitted, and where this vicious conformation exists, and especially if it be attended with decided symptoms of debility of the respiratory functions (p. 89), even though no indication whatever is found of the existence of tubercles, in connection with the other elements of our diagnosis, it is of the highest value. So, also, in children especially, with the bones of the skull imperfectly, irregularly, or unequally developed, the first signs of the derangement of the sensorial and intellectual faculties will frequently clear up the diagnosis.

To avoid errors, it should be remembered that, in some of the most chronic cases, signs of the localization of the disease occur before any marked symptoms of the general disease; before emaciation, febricula (p. 105), or even before any degree of debility is admitted by the patient; but in all these cases, on strict enquiry into the history of the case, we do not fail to find some of the indications of the tuberculous habit; or the antecedents, which have been so often referred to; although, notwithstanding their existence, the patient may have enjoyed, in ordinary, a good state of health.

The importance of steady *loss of weight* has been pointed out (p. 69); Dr. Walshe lays it down as an aphorism, that in young adults, where no clear cause is present, as secondary syphilis, or spermatorrhœa, or dissolute habits, there is in all probability phthisis, "even though no subjective chest-symptoms exist."* Under these circumstances, it is one of the most valuable diagnostic signs of tuberculosis, but its value is greatly increased when it occurs in those who exhibit the signs of the tuberculous predisposition, and especially where there exists the hereditary tendency. We may also generalize the following aphorism by Dr. Walshe—"Failure of weight becomes less valuable as a sign of tuberculosis (phthisis), the longer the thirtieth year has been passed."

* On Diseases of the Lungs and Heart, p. 395.

In *children,* and especially young infants, tuberculosis frequently sets in as an acute disease, and, like the acute tuberculosis of adults, it runs a rapid course. In this case, the fever and other symptoms may be confounded with the febrile diseases of infancy. Before local disease sets in, this febrile state may be recognized by its moderate degree of intensity, and by its long persistence without any local symptoms. After the lapse of a fortnight or more, when all chance of an eruptive fever, or of a local inflammation has passed over, and particularly at the period immediately subsequent to the occurrence of these diseases, the persistence of a febrile state renders the existence of tuberculosis probable. If the symptoms have a typhoid character, the difficulty of the diagnosis is increased; and there may be cases in which it is impossible to avoid error, since many of the most prominent symptoms are common to the two diseases; but even here, the case of tuberculosis may sometimes be distinguished by the long continuance and the slight intensity of the fever, with the absence of those symptoms which especially characterize typhoid fevers.

When the disease is more chronic in infants and young children, the subjects of it become pale, fretful, indolent, disinclined to play or to be amused, and emaciation sets in, either with or without diarrhœa. These symptoms arising insidiously, and continuing for many weeks or months, especially where there is no error or deficiency of diet to produce them, are highly significant of the disease, and these points of diagnosis are here of the more importance, since the first, and even the after stages of the tuberculization of organs, frequently occur in these young subjects, absolutely without any symptoms by which they can be detected, and we are thrown for weeks and months upon the symptoms of the disease of the blood alone, to determine our diagnosis. Palpation of the abdomen, auscultation, and percussion, frequently fail us in these cases. Rilliett and Barthez lay it down as a diagnostic rule, that, if a child with these symptoms exceed three or four years of age, whether combined or not with diarrhœa, they are, in a majority of instances, referrible to tuberculosis; but in younger infants, the same symptoms are almost always associated with diarrhœa;—and although they may depend upon tuberculosis, they are more frequently referrible to hypersecretion from the mucous membrane.

In children of a more advanced age, when a feverish attack is converted gradually into a chronic disease, with gradual wasting,

we may presume the existence of tuberculosis, since there are no other chronic diseases incidental to this age. The infantile remittent fever frequently in this way passes into mesenteric decline, or phthisis. When fever or debility is prolonged after hooping-cough, measles, scarlet-fever, and some other definite diseases, if it depend on a tuberculous state of the blood, local disease generally supervenes quickly, and the diagnosis is removed from the more obscure question of a disease of the blood to that of a definite organic affection. In children from five to fifteen years of age, when chronic tuberculosis occurs, the diagnosis is sometimes very obscure; there may be insidious wasting, with debility and listlessness, without any fever or loss of appetite, and scarcely any local symptoms. In many of these cases our diagnosis must for a long time remain doubtful.

These, I believe, are the most important diagnostic considerations which science in its present state supplies for the detection of tuberculosis as an idiopathic disease of the blood, viewed independently of local complications. They are derived, in part, from the practical works of Fournet, and Rilliett and Barthez, and are those which have been confirmed by our own experience.

SECTION III.

THE PROGNOSIS.

Although sometimes treated very cursorily, even *ex cathedrâ*, this subject also is one of great importance in a practical point of view. I include in the signification of the term, not only the prediction of the final event of the disease, but the anticipation of various circumstances in its progress, and those especially which relate to the element of *time*. The opinions required of the practitioner under this head are of paramount importance, and there have oftentimes been reasons to regret that no attempt has been made, by practical writers, to lay down some guiding principles. The deficiencies of our knowledge constitute no valid reason against it; and, in fact, on this, as on many other points, however insufficient the data, principles, as far as the science will allow of, are far surer guides than pure empyricism. There is no disease in which a correct prognosis is of more consequence to the welfare of the patient, and none in which it is more difficult.

As to the period required to *produce* a tuberculous state of the blood, a knowledge of which would constitute a valuable element

of a just prognosis, I am not prepared to state anything very definite. In Dr. Jenner's and Dr. Baron's experiments on animals, where anti-hygienic influences were in full operation, about six weeks or two months elapsed, from the commencement of the operation of the causes of the disease to its fatal termination, from what they considered tuberculosis of the liver. In a climate favourable as a prophylactic against the production of tuberculosis, as in India, individuals shut up in a close prison, were confined there for a long period, from two to three years, and sometimes experienced several attacks of pneumonia before their blood became tuberculous (p. 490). In our own jails, the rapidity with which the disease is produced, depends upon the discipline and the number of ancillary causes which may be in operation. In close confinement, without exercise, in a badly ventilated jail, with deficient or bad diet, it has doubtless frequently been induced as quickly in man as in the lower animals under similar circumstances, viz.,—in six weeks or two months, or even more rapidly; and in proportion as these anti-hygienic influences are diminished, so is the period of incubation of the disease prolonged. But in forming an opinion on this point, the original constitution and the hereditary history of the individual must be taken into account.

The prognosis as to the *event*, where a tuberculous state of the blood is indicated, either by the general signs and symptoms of the predisposition alone, or with the slighter scrofulous affections, is in the main favourable; the character of the local disease assists us in arriving at a determinate judgment as to the state of the constitution, and this at a time when the blood disease is curable by the efforts of nature, or by hygienic and therapeutic measures. The prognosis as to *time*, even in this stage or period, is very uncertain; each case stands upon its own merits. Much depends upon the stage at which we are called upon to form an opinion, and very much upon the previous habits of the invalid, or the treatment to which he may have been subjected. Perhaps such a table as that given from M. Lebert (XVI, p. 404), is better calculated to assist the rationale where local disease has set in, than any rules that can be laid down. We there see that ten out of eleven cases terminated in less than six years, and about three out of five in less than two years, while only about one-tenth terminated within six months. I believe the forms of the disease included in the table are of shorter duration in this country, and that they terminate still sooner in warmer

climates. We find also, by the same table, that tuberculous ophthalmia is of longer duration than any other external tuberculous disease.

Where external tuberculosis affords indications of the deposit of tubercle (p. 227), the prognosis either as to the event or the *duration*, is modified; as respects both, it is less favourable. At the same time, where, even in an individual with an hereditary tendency and of a tuberculous habit, we find tubercle deposited in the external glands and proceeding to suppuration, we may regard the occurrence as justifying a favourable prognosis as respects the internal deposit of tubercle. It is an undoubtedly just observation, that of the children of tuberculous parents, those who have glandular affections in early life more frequently escape consumption subsequently, and those who die of consumption have most frequently never exhibited any signs of the deposit in the external glands (p. 365—9). But still, we must be very careful in our prognosis, for, on the other hand, where the tuberculous state of the blood is inveterate, we sometimes find that the glandular affection, whether in the external, the bronchial, or the mesenteric glands, is but the forerunner of a deposit of tubercle, either generally, or in some vital organ, and as a consequence, of the death of the patient.

To assist our prognosis, both as to the event and its period, the following general enunciation may also be made. The localization of the disease, either in the form of scrofulous inflammation or the deposit of tubercle in the lymphatic glands, the cutaneous and adipose tissues, the bones, articulations, larynx and trachæa, spleen, pancreas and uterus, rarely compromise life, even in children, until tubercle is deposited in the lungs, liver, mesentery, gastro-enteric surface or the membranes or substance of the nervous system; either of which occurring, during the slow progress of the constitutional disease, may render it certainly fatal, and lead very quickly to this result; and in adults, or after the age of 15 years, according to the law laid down by Louis, the prognosis is, more certainly still, determinable by the actual state of the lungs.

The prognosis must, in fact, be regulated, not only by the actual existence of local disease and its tendencies, but by the more special predispositions of the patient; and by the stage, both of the local and the general disease. Scrofulous disease of a bone, for instance, may be perfectly curable in the first stage, although almost necessarily fatal when the blood has become in a high

degree tuberculous, and has begun to deposit tubercle. So, also, in mesenteric tuberculosis, without any signs of pulmonary disease, the prognosis, founded on the facts of pathological anatomy, (p. 244), is much more favourable than where the lungs exhibit signs of disease; and it becomes still more favourable if the chest be well formed or free from that special conformation (p. 29), which is not only a sign of the tuberculous predisposition, but a predisposing cause of disease of the lungs.

In foretelling the events of this disease, it is also necessary to bear in mind, that the sudden disappearance of external affections is frequently followed by a manifest aggravation of the tuberculous affection of the blood, increased deterioration of the general health, and a vicarious deposit of tubercle. This may occur under circumstances, in which it is doubtful whether the retrocession of the external disease is the cause or the effect of the development of internal disease, or whether the two are coincident and consecutive to the operation of some common cause. When increased derangement of the general health, and the occurrence of pulmonary phthisis, or tubercular meningitis, follow the rapid retrocession of external scrofulous affections, produced by therapeutical means, as sometimes happens, without any other known exciting cause, the inference is obvious enough, and the utility of a knowledge of the sequence of phenomena, in reference to prognosis, is equally obvious.

Again, I derive the foundation for the following principle from Dr. Addison's work:—

When infants and young persons, whose blood is in the slightest degree tuberculous during growth and development, become affected with disease, the anatomical changes of tuberculosis frequently take place, and the structures become deteriorated, either with or without the deposit of tubercle. If they recover from such diseases, and, under a favourable convalescence, the vessels are renovated with healthy blood, in the place of the tuberculous blood used up in the disease,—their general health may be improved by the supervention of such diseases; the anatomical changes of structure alone remaining with a certain degree of permanency. If, under favourable hygienic circumstances, they continue to make good blood, even the most permanent structures of the body may in time recover a healthy organization; although, for very obvious reasons, this but rarely takes place. But such

structural deterioration, so long as it lasts, must always act as a predisposition to a future invasion of the malady. These anatomical changes may endure, in a latent form, without symptoms or signs, even throughout a long life; but they may also become active at any time; and, if the newly-formed blood be still tuberculous, this activity is often quickly manifested in the various sequelæ which occur after the original malady gets well.

That a tuberculous state of the blood may be corrected, whether by nature, or nature aided by art, pathological anatomy leaves no doubt; but one of the most important questions is, how far this may be possible after tubercle is deposited in the various organs, and especially in the lungs. Laennec admitted the occasional cure of tuberculosis pulmonalis in the second or third stages, and Fournet's work is especially directed to prove its curability in the first stage. Hirtz also, and some other modern writers, have taken great pains to establish the latter view. We have shewn the curability before the deposit of tubercle; but the great question here is, whether the blood is capable of restoration to a healthy state after tubercle is deposited in the lungs and other internal parts, and throughout the various phases of tuberculization in the different organs. Science affords a most positive answer in the affirmative.

In no stage of tubercle, when seated in the lungs or mesentery, for instance, can the blood disease be regarded as absolutely incurable. The pathological facts, recorded by Carswell, Laennec, and numerous pathologists, affording evidence of the cure of tubercular excavations, at all ages, and in various parts of the body, are proofs that the tuberculous state of the blood must have been cured. Since the local disease is the consequence and not the cause of the malady of the blood, the aggregation of tubercle once commenced in an organ will not cease, or an excavation once formed, it will not heal, without a previous change in the blood. The fatality of the blood disease is, no doubt, aggravated and rendered more certain by the supervention of local disease; the disturbance of the function of the lungs, mesentery, brain, liver, or any other organ, even by simple malnutrition, but more especially by the aggregation of tubercle in their tissues, or the supervention of hectic fever, and the anti-hygienic influences of the sick chamber, all conspire to precipitate the final result; but the frequently slow progress of the disease under all these unfavourable influences, particularly where no vital organ is affected to a sufficient extent

to compromise life immediately, the frequency with which the patient rallies if judiciously managed, even where a vital organ is unquestionably affected, and the occasional cure of the disease under the latter circumstances, are clear indications that up to a very late period indeed, the tuberculous state of the blood ought not to be regarded as incurable.

Thus tuberculosis, whether it have manifested itself in the form of scrofula, of tuberculosis of the lung, mesentery, peritonœum, or bronchial glands, must still be regarded as a curable disease. When in children, the signs of the deposit of tubercle in the brain set in, this may necessarily entail a fatal prognosis, but it is formed from a knowledge of the physiology and pathology of the brain, and so also in relation to every other organ, in any individual case our prognosis must be formed in reference to the signs and effects of organic mischief, but at the same time we ought to keep steadily in view the curability of the disease of the blood.

We regard this view of the case as of the highest importance in practice. The principles of treatment to be adopted, in any case, refer either to the treatment of the local disease or to that of the general disease, and are not infrequently inconsistent with each other; the local mischief can never be repaired so long as the blood continues diseased: if the blood, either by the resources of nature alone, or by those of nature assisted by art, resume its normal constitution, and its healthy vitality, the local affections, if no vital organ be too extensively diseased, will get well spontaneously.

Except probably in young infants, it is not likely that, in many instances, death will result from a tuberculous state of the blood previous to a deposit of tubercle, or without the occurrence of some exhausting local disease. As the tissues become emaciated, and the debility increases, the aggregation of tubercular particles occurs more readily, and congestions, inflammations, ulcerations, and tuberculous suppuration are more easily set up. The extent, however, to which the general affection may proceed, and the period of its duration without any local manifestation, are extremely variable, and must depend upon the simultaneous action or the supervention of the exciting causes of local disease. It sometimes happens, that no sooner does the blood become tubercular than, owing to the operation of such causes, local disease manifests itself; or, owing to the absence of any predisposition to local

disease, and of every exciting cause of local disturbance, the tuberculosis proceeds to a great extent before local disease manifests itself. It is important, however, to bear in mind, that individuals have sunk with all the symptoms of general tuberculosis, and added to these, even cough, expectoration, and diarrhœa, and, on post mortem examination, every organ has been found to be sound. Instances are furnished by Lieutard, Sauvages, Van Swieten, and Christopher Bennett. It also happens, not infrequently, that a tuberculous case proceeds to its fatal termination, and after death a few tubercles only are found in one lung, by far the larger portion of the lungs and all the other organs being perfectly free; a state of the vital organs which is totally inadequate, *per se*, to destroy the patient. These circumstances shew how important it is in reference to prognosis, to watch the progression of the general symptoms.

In tuberculosis, with the internal deposit of tubercle, we are frequently called upon to give an opinion as to the probable duration of the disease, either where a fatal or a favourable prognosis is given. The circumstances relating to the duration of tuberculosis as a blood disease have been stated (p. 403); but in a vast majority this opinion is elicited in reference to particular forms, and it can be founded only on our knowledge of the history, symptoms, and character of the local diseases engrafted on the tuberculous state of the blood. In children, for instance, the duration is generally shortest when the brain is the seat of the disease; in adults, when the symptoms of acute tuberculosis of the lungs sets in. In children, the duration of acute tuberculosis when the lungs are attacked is from sixteen or eighteen to sixty or eighty days; and of chronic tuberculosis, after local disease sets in, from forty-five or fifty days to one or two years, but it most frequently runs its course in from three to seven months (Rilliett and Barthez). The probable duration of external scrofula may be derived from Table XVI, and of phthisis in adults, from the statement appended to it. In forming an opinion on this point, in any individual case, we have to regard—1, The general symptoms and the history of the blood disease;—2, The history of the local manifestation.

Every prudent practitioner will exercise the very greatest caution, even in the most advanced and necessarily fatal cases, in their prognosis as to time. The propriety of this follows especially from the

following considerations :—Death by the blood disease is essentially slow, the blood becomes gradually more and more affected, and the nutrition over the whole body ceases. Ultimately, it would appear, that the blood is totally incapable of furnishing, not to say an imperfect blastema, but a blastema in which fibrillation and cell-nutrition is possible. Its tint is very often changed, appearing, through the transparent tissues, of a pinkish-violet shade; and the larger cutaneous vessels, although very thinly covered with the surrounding tissues, are comparatively empty. Where no intercurrent affection of the nervous system intervenes, the maintenance of the nervous and intellectual power to the last is truly wonderful. The appetite continues good, the functions of the alimentary canal perfect, the senses keen, and the intellect clear, in the midst of the havoc produced by the general failure of the nutritive functions; but that this exhibition of vital force is fallacious, as to its real amount, and the constancy of its supply, is shewn by the exhaustion which intervenes, and by the frequent occurrence, under these circumstances, of a suddenly fatal issue, before the local complications have run their complete course. A knowledge of these facts induces the necessity for the caution we have mentioned; a patient whose existence might be expected to be prolonged for weeks, or even months, will sometimes die from exhaustion alone, on some slight change of position or any severe mental impression. We have seen men engaged in their business a day antecedent to death brought about in this way; and a lady has been known to order her carriage, pay visits, and die within a very few hours afterwards; so also the fatal event will sometimes follow where the appetite has been good to the last, and very shortly after a full meal.

When tuberculosis pursues its ordinary course of the deposition of tubercles in organs essential to life and a fatal termination, the tuberculosis, simply considered, constitutes a distinct period of the disease. Until the formation of hectic fever, we have frequently the tuberculosis almost alone to explain the symptoms, and to advise us of forthcoming events. To this period, although some of the local effects of tubercles may exhibit themselves, they are insufficient to account for the increasing emaciation and debility; while these are progressing rapidly the cough and dyspnœa may be so slight that they are "often little remarked by those affected, and sometimes so little as to be absolutely denied by them." Nor

can the hectic fever, even though it has for some time set in, be considered as the cause of death in all cases. This fever appears to produce such a result, only by increasing the emaciation and debility; but both these proceed even with greater rapidity before than after hectic sets in; and the diseased state of the blood, which is capable of producing these effects, in the previously healthy or predisposed subject, must, if continuing to operate, produce still greater effects when the body is weak and attenuated, so that the hectic fever can only be regarded as an aggravating cause. Independently of this consideration, it is doubtful whether hectic fever is capable of producing the effects frequently imputed to it; an individual may continue a long time under its influence when induced by other causes than tubercle, and yet recover very rapidly when the cause is removed. Hectic is unlike fevers in many respects; after the paroxysms subside the patient appears to be very little debilitated by it. The progressively increasing deterioration of the blood, by which its vitality is lowered to a degree which renders it totally incapable of sustaining the vital functions, is the cause of death. The diminution of red corpuscles probably proceeds to such an extent as to render the blood incapable of absorbing and carrying a sufficient quantity oxygen, and a fatal exhaustion must result; when an organ is diseased to a considerable extent, it must facilitate the fatal event,—the respiration, for instance, although becoming more rapid in consequence of the increasing demand for oxygen, is not sufficient to compensate the rapid loss of respiratory surface.

Another consideration of some importance is, that our prognosis is somewhat qualified by the *age* of the patient. The younger the patient, *cæteris paribus*, when the blood disease is advanced to a certain extent, the greater tendency to local manifestations, the more generally diffused the deposit of tubercle, the more rapid the progressive metamorphosis of the blood and the destruction of organs, the shorter the duration and the more inevitably fatal the disease. The older the patient, the less inveterate the disease of the blood, the greater the tendency to limitation of the deposit to a single organ or to a portion of an organ, and the more favourable the prognosis in every respect. Notwithstanding the frequency with which morbid anatomy furnishes the evidence of the prevalence of tubercles in the lungs of old persons, (p. 364), M. Prus records of 390 old people, who died at the Bicêtre in three

years, eighteen only were cases of phthisis.* It has already been shewn that the susceptibility to the disease from birth to old age in all probability occurs in a decremental series, and it is perfectly clear that the liability to death, at all events from the age of twenty years, observes this law (Tables XIX, XX); but how far this statistical result may depend upon the diminished susceptibility, and how far upon the more frequent cure of the disease, cannot, we believe, be conjectured, although general opinion accords nothing to the influence of the latter.

In *infants and children,* where a tuberculous state of the blood is unequivocally established, to the extent of depositing tubercle, the event, as far as we at present know, is but too generally fatal. But even in young subjects, in whom the blood is so favourable to the tuberculous transformation, the facts developed by pathological anatomy clearly establish the possibility of a cure. There can be little doubt that children sometimes recover from tabes mesenterica; tuberculous excavations of the lungs are also occasionally cicatrised, even in young subjects; but the most frequent case of a cure, in such subjects, is where tubercle has been deposited in the external glands. If the disease is susceptible of cure after the deposit of tubercle in any locality, there can be no doubt of the curability of the blood in this stage; and, accordingly, where, from the existing symptoms, the family history, and the conformation of the child, we have the most reason to believe the existence of a tuberculous state of the blood, and there is no evidence of the local deposit of tubercle, we are warranted in pronouncing the disease curable, and it is unjustifiable to treat with levity the resources of art or the means of improvement at our disposal.

In young subjects, the fatal termination is indicated by all those symptoms which have been described as constituting the last stage of tuberculosis; loss of appetite is one of the symptoms which indicates a more rapid progression of the disease for the future; in children, as in adults, it is always a bad sign when the patient takes to bed, and is either unwilling or unable to quit it; although the disease may be protracted for a considerable time afterwards, still it shews the gradual progress of the disease, and the length of time which has elapsed from the first attack of illness to this event, enables us to form some idea of the rapidity with which it is

* Monneret and Fleury: Dict. de Med., tom. vi, p. 525.

progressing, and to pronounce approximately as to the future. When the emaciation has proceeded gradually, but suddenly increases, some new organic complication is indicated, and a more speedy termination than was previously regarded as probable. In children, œdema of the face, and violet discoloration, the latter especially, are omens of speedy fatality.

The *season of the year* and the state of the *weather* lend us no assistance in the prognosis as to the event, since the opinion that any of these diseases are more fatal at one season than another has been shewn to be an error (pp. 507, 539). Fine, warm weather is, however, favourable to recovery in external scrofulous affections, and their duration is shorter, but rather from the opportunity it affords of fulfilling the curative indications, than from any direct or abstract effect of season.

The *signs of recovery* from a tuberculous state of the blood, consist of a gradual cessation of the symptoms of direct debility, which may have manifested themselves, a gradual return of the patient's strength, the manifest circulation in the vessels of blood of better quality, the gradual but steady recovery of weight, and the persistence of the signs of improvement, notwithstanding the temporary influence of the causes of tuberculosis.

The greatest caution is necessary in pronouncing a patient cured who has once been tuberculous. Blood, once tuberculous, whether by hereditary descent or by acquisition, is so prone to relapse under the original or new anti-hygienic influences, that it requires good judgment to determine when those therapeutic rules which may have been adopted should be relaxed, and to pronounce when, or under what circumstances, the patient is safe. At the period of convalescence, patients or their friends most frequently take the law into their own hands, and many have, accordingly, lost their lives who might have distanced the disease had they continued to follow medical advice. For this the profession is not amenable, but if we overlook the *tendency to relapse*, and sanction the injudicious proceedings of others, not only ourselves individually, but the science of medicine suffers in public estimation.

SECTION IV.

ON THE RELATION OF TUBERCULOSIS TO OTHER BLOOD DISEASES.

Our knowledge of the physiology and pathology of the blood, leaves no room to doubt, that while in a tuberculous condition, it

may take on various forms of disease, producing different effects on its tuberculous state, according to the nature of the chemico-vital actions brought into play. Tuberculous blood may receive, for instance, the poison of small-pox; and the latter disease will pass through all its phases in tuberculous as in healthy subjects. Many writers affirm, that the small-pox sometimes cures tuberculosis, and it is by no means improbable, that the complete change and the perfect renovation which it must undergo during the active stage of this disease, and the convalescence which follows, may in some instances supersede its tuberculous state, and result in perfect health. There are not wanting facts to countenance the notion that other eruptive fevers, by the radical change effected in the blood, have sometimes restored it to a healthy condition, when previously affected with tuberculosis. On the other hand, after eruptive fevers, and other blood diseases, wherein a tumultuous disturbance of the molecular actions in the blood takes place, if the healthful functions of hæmatosis be not perfectly restored in due time, and in particular if the respiratory function has been disturbed and not perfectly restored, as frequently happens in measles; instead of being checked, the tuberculosis is precipitated.

Some diseases appear to exclude tuberculosis, without our having the slightest clue to an explanation of the circumstance; as in the case of *cystic tumours*, and particularly those of the *ovary*, which in Rokitansky's numerous inspections were very rarely met with together with tubercle. Both Rokitansky and Hasse regard *Bronchocele* also as incompatible with tubercle. Hunter remarked, that *gun-shot wounds* are rarely followed by consumption; he never saw a case in which such an effect took place. Tuberculous blood would appear to become but rarely *chlorotic*, or at all events, Lebert found young scrofulous females very seldom affected with *chlorosis*, (l. c. p. 327); he considers that the retardation or cessation of menstruation in the two diseases arises from different causes; in tuberculosis, the ovules are not maturated; in chlorosis, the pale defective blood does not furnish the menstrual fluid; the state of the blood is also very different, but at the same time, as shewn in the preceding chapter, chlorotic blood sometimes passes into tuberculosis, and the former disease, when long continued, operates by predisposing the system to the latter. The symptoms and progress of tuberculosis, are also not infrequently modified by *functional disturbances and diseases of the liver*, result-

ing in an accumulation of the colouring principle of bile in undue quantity in the blood, constituting cases of tuberculosis complicated with *jaundice*. The true relations which subsist where these affections occur together, and the antagonistic circumstances where they exclude each other, have in no sense been investigated.

Scorbutus.—Dr. Lind remarked, that persons very much emaciated with consumption, are seldom or never seized with the scurvy. * Dr. Beddoes, on theoretical grounds, endeavoured to establish that scurvy being a disease of deficient oxygenation, excludes phthisis; † but other writers on this disease, describe consumption as one of its most frequent complications. There is in truth, no condition of the blood, which exercises a more obvious influence over tuberculosis, than that which occurs in scurvy. This circumstance has been remarked, by some of the more recent observers. In the Surgeon's report of Sir J. Ross' residence in the Arctic regions, it is recorded, that consumption occurred in scorbutic subjects, and was modified by the controlling influence of the scurvy. ‡ Dr. Cook describes the effects of a scorbutic state of blood over the phthisical and mesenteric forms of tuberculosis,—night sweats are not so common as in pure tuberculosis; tremblings, rigors, flushes, faintings, convulsions, and want of sleep, are predominant symptoms. § and belong rather to the scorbutic than to the tuberculous disease; and the patient frequently dies of the scurvy, before the tuberculous affection has fairly developed itself.

The state of the blood in scurvy, which like tuberculosis, is strictly a blood disease, affords some explanation of the effects. From Mr. Busk's analyses, ‖ in scurvy as in tuberculosis, there is a diminution of the solid constituents, and especially of the blood corpuscles, the cypher of which is even lower in the former than in the latter disease, but with an increased proportion of the albumen; all which circumstances may account for the one diseased state of the blood becoming ancillary in its effects to the other; but there is at the same time, an increased proportion of fibrine and such an excess of salts in scurvy, which does not appertain to tuberculosis; leaving no reason for surprise, that new and

* A Treatise on the Scurvy, p. 508. † Observations, 1793, p. 131.
‡ Appendix to the Narrative of Sir J. Ross, p. 122.
§ Quarterly Journal of Foreign Medicine, vol. i., p. 544.
‖ Simons' Chemistry, vol. iv., p. 315.

complicated symptoms should arise, where the two morbid states co-exist. In making this comparison, however, even admitting the accuracy of the analyses, we must not overlook the fact, that the formulæ of the constitution of the blood, are but expressions of the effects of some more essential—but, at present, unknown changes.

The differential condition of the blood in the two diseases, is also well marked, by the condition of the urine. The urine in scurvy is usually dark, reddish brown, and in some forms of the disease, of an almost black colour, and there is a marked deficiency of the phosphates; characters which are never met with in simple tuberculosis, (pp. 46, 83), nor in any variety of this disease; and which are totally distinct from those of hectic fever. It has also a greater tendency to become alkaline and to develope an ammoniacal odour in scurvy, than in tuberculosis. Thus the state of the urine corresponds with that of the blood in either disease; and we have an illustration of two distinct diseases of the blood, which sometimes co-exist in the same individual.

Cancer.—Rokitansky concluded from his innumerable dissections that cancer and tubercle are incompatible, and Mr. Simon has designated these diseases as "pathological antitheses to each other in regard of the blood." The latter has suggested the idea, that in tuberculosis there is a diminished vitality, in consequence of which a portion of the blood never attains its mature growth or function, and is thrown out of the system in an imperfect state *before it reaches* the circulation (p. 560); whereas, in cancer "there is an excess of vitality which will not be quenched;" in cancer the blastema from the blood furnishes profuse living growths, or organized excretions, instead of perishable concretions, as in tuberculosis. (Lib. cit., p. 187.)

Dr. Walshe, in his very complete work on "The Nature and Treatment of Cancer," has fully described the pathological distinctions between these two diseases,—disease of the uterus, mamma, stomach or liver,—which furnish about seven-eighths of all the deaths caused by cancer, are very rarely the seat of tubercular deposit, and never, in the adult, become its primary site. The lungs, almost the invariable seat of tubercle in the adult, furnish but a contemptible fraction of examples of primary cancerous disease. The cœcal end of the ileum is the special intestinal seat of tubercle, and it is doubtful if cancer has ever been observed there. Those alterations of the blood which occur in both diseases,

as the diminution of the red corpuscles, form in part the essence of the disease in tuberculosis, but are secondary and accidental only in cancer (p. 185).

Dr. Walshe* has also well described a distinction between these two blood diseases very generally observed. He remarks that in cancerous disease, as in phthisis, there appears to be some material pathological condition present which gives a distinctive tone to the affective and moral faculties. Cancer gives a sad and gloomy character to all the ideas; its victims never entertain exaggerated notions of their chances of recovery; their temper is habitually more or less morose and captious. Although this mental state may have some association with the constancy and severity of the pain endured, it does not wholy depend upon this; no more than the serenity of temper and hopefulness of the consumptive can be referred to freedom from bodily suffering. In cancer, extreme mental depression may exist though pain be absent, while even physical tortures will not always sour the temper or crush the hopes of the phthisical. Dr. Walshe thinks it a reasonable conjecture, that the condition upon which these distinctive mental characters depend, will eventually be shewn to reside in the blood: "Some modifications of that fluid affecting in each case the nerves and cerebral organs."

Notwithstanding the infrequency of the coetaneous occurrence of tuberculosis and cancer, the distinctive characters of their history and symptoms, the thousands of cases of the former disease which occur without any trace of cancer, and the large proportion of the latter without any trace of tubercle, there can be no doubt that, as an exception, cancer is sometimes found in tuberculous subjects, or tubercle in cancerous subjects. In 104 narratives of the post mortem examinations of adults cut off by cancer, Dr. Walshe found seven in which the anatomical character of phthisis was present; 72 cases of encephaloid furnished but two examples of tuberculous disease; facts, as remarked by Dr. Walshe, totally opposed to the opinion that encephaloid is allied to scrofulous disease, or that it is cancer modified by a strumous constitution. (Lib. cit., p. 185.) "The existence of cancer in any organ is unfavourable to the presence of tuberculous disease; but tubercle and cancer *may* coexist, even in the same lung."† Whether there are any facts to shew which disease is engrafted upon the other,

* On Cancer, p. 127. † Dr. Walshe on Diseases of the Heart and Lungs, p. 376.

I am not aware, but the occurrence is sufficient to prove that these diseases do not absolutely exclude each other. It does not appear that a cancerous state of the blood exercises any marked influence over the progressive development of the tubercular disease.

Gout.—Although it has frequently been held that gout, scrofula, and consumption, are modifications of the same disease, and that individuals affected with the scrofulous form in early life become gouty in old age,* the assertion has never been supported by statistical evidence. There is reason to believe that gouty and tuberculous blood are antagonistic of each other. Gout and phthisis rarely occur together, Fournet says never (vol. ii, p. 837). The alterations both of the solids and liquids which constitute the gouty habit differ entirely from those of tuberculosis. The temperament which predisposes, and the treatment of the two diseases, are opposed.

Diabetes.—Tuberculosis and diabetes are by no means infrequently associated together, and the greater number of cases of diabetes become complicated with tuberculosis pulmonalis before death. Dr. Copland states that he scarcely ever met with a case that was entirely uncomplicated with pulmonic symptoms,† and several other writers make a similar remark; but diabetes occurs independently of tubercles, and in constitutions perfectly free from any signs of tuberculosis; and in a vast majority of the cases of the latter disease there is not the slightest indication of diabetes. The two morbid conditions, however, occurring together, react reciprocally on each other, the symptoms of both are aggravated, and a fatal result hastened.

Some writers have held that the tuberculous affection constantly precedes the diabetes, and others that it occurs consecutively. The occasional coincidence of the two diseases, and also of minute quantities of sugar in the urine in phthisis, where decided diabetes is not present, are referred to by Dr. Walshe (lib. cit. p. 389) as subversive of the hyper-oxydation theory of the former disease.

Granular Disease of the Kidney—Bright's Disease.—The pathology of this disease and of tuberculosis, in their relations to each other, has been treated of in a former chapter (p. 304). That granular disease of the kidney differs essentially from tuber-

* A. A. Sebastian—Brit. and For. Rev., July, 1839, p. 242.

† Dictionary of Medicine, vol. i, p. 508.

culosis, is evident from the state of the blood in the two diseases. In the former, the albumen runs off by the kidneys and leaves the liquor sanguinis with a greatly diminished proportion of this element; the urea accumulates so as to be detectable by chemical tests, and is frequently associated with an excess of fibrine; none of which circumstances belong to tuberculous blood. (p. 15.) So that, from the pathology of the fluids and solids, we must regard this disease, when it occurs, as an accidental complication, but one which leads to the death of the patient, independently of the tuberculosis; as indicated by a fatal result frequently occuring while there are yet but a few tubercles in the lungs at their apices; and also by its occurrence, in some cases, where there exists the usual evidence of recovery from the local deposit of tubercle.

Chronic Venosity, or defective arterialization of the blood.— In that peculiar condition termed *cyanosis*, in which it is presumed that there is a defective arterialization, and in many chronic states of the system in which the blood retains the venous character, there appears to be an exemption from tubercular diseases. We have already shewn that in advanced life, when the venous character of the blood predominates, tuberculous affections decline in frequency (p. 407), and their curability increases. Also, that in persons who drink to excess, and in whom the blood is generally regarded as dearterialized, the pathological results of a tuberculous state of the blood are rarely met with. (p. 457.) Rokitansky enumerates hypertrophy of the heart and continued patency of the foramen ovale, aneurism of the aorta, affections of the spine, and especially deformities which narrow the chest, abdominal tumours encroaching upwards and impeding respiration, emphysema, and every influence which interferes directly or indirectly with the oxydation of the blood, by diminishing the capacity of the chest or the expansion of the lungs, or by deranging the pulmonary circulation of blood, or impeding the access of air, as incompatible with tuberculosis. The state of the blood under these circumstances is represented not only as differing from that of tuberculosis, but as being antagonistic of, or prophylactic against, this disease.

These circumstances, as well as the facts relating to scurvy, might be advanced in favor of the theory of Dr. Beddoes, and it might be assumed that they all operate by deoxydating the

blood, or rather by preventing its hyper-oxydation. Physiology and pathology teach us, however, to regard the blood in its complicated relations of liquor sanguinis and blood corpuscles, or of protein, oil, iron, oxygen, &c., and any sweeping explanation which mixes up all the materials of the blood, pell-mell, in one general assertion, committing so flagrant a violence upon the complex idea of "BLOOD," must now be rejected.

Typhus and Typhoid Fevers.—M. Andral proved clinically that typhus and typhoid fevers are rarely followed by tuberculosis. M. Louis, however, found apparently recently developed tubercles, several times, in subjects who had died of prolonged typhoid fever; and Dr. Copland sets down pulmonary consumption as one of the *sequelæ* of these diseases.* Rilliett and Barthez regard them, in children under 15 years of age, as exercising a true antagonism; and Rokitansky states that tuberculous subjects are rarely attacked with typhoid fevers. The product peculiar to typhus has been said to be analogous, if not identical to tubercle, but this has not been established.

The blood in typhoid fevers differs essentially from tuberculous blood; the fibrine is either normal, or decreased, or increased in a slighter degree than in inflammatory affections in general, according to the existence or not of visceral inflammations; but the proportion of blood corpuscles is from the beginning to the termination either absolutely increased, or their proportion to the fibrine is relatively increased, and the quantity of solid constituents is frequently larger than in health; the clot is accordingly large, soft, almost of a *black*-red colour, and becomes putrid sooner than normal blood;† comparing these qualities with those which distinguish the tuberculous state, there can be no doubt of the totally different condition of the fluid in these two diseases.

It is also worthy of note, that the susceptibility of the blood to the action of the poison of typhus and of typhoid fevers, is least in children and increases as age advances, and the mortality amongst those attacked increases, in an accelerating ratio with the advance in age;‡ whereas, the susceptibility of the blood to the tuberculous transformation is greatest in early life, and decreases in an accelerating ratio as age advances. (p. 408.)

Intermittent Fever.—A passage in Hippocrates, although of a

* Dict. of Medicine, vol. i, p. 1008. † Simon's Animal Chem. vol. i, p. 287.
‡ Copland's Dictionary, vol. i, p. 1012.

TABLE XXXI.

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 neighbourhood fenny	Where Intermittent Fever prevails Consumption does not	Dr. Marshall
Hurstperpoint, 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, &c.
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 1-10 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 the borders of the Lakes	No mention of Pulmonary Consumption	Dr. Walshe
Portsmouth, New Hampshire	Mild climate, Intermittents probably infrequent	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, English Con.
South Carolina	Intermittents exceedingly frequent	Consumption rare	Dr. Wells
Bermuda	Very free from Intermittents	Consumption much more frequent than in S. Carolina	A Gentleman
Maderia	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

doubtful character, appears to indicate that the father of medicine had observed, in Greece, that intermittent fevers superinduce an immunity from phthisis. (Sydenham Ed. vol. i, p. 355.) Sydenham, Hoffman, Lancisi, and Boerhaave, also thought that intermittents act as prophylactics, not only against phthisis, but also against various diseases, and that they even dispose to longevity—"Febres intermittentes, nisi malignæ, ad longevitatem disponunt, et depurant ab inveteratis malis." Dr. Wells, in 1811, having heard as long previously as 1779, that in Flanders consumptive persons moved to the fenny districts for a cure of the disease, was the first who endeavoured to *prove* that an antagonism exists between intermittent fever and tuberculosis. (Consumption * and Scrofula.†) This opinion was founded upon a very considerable number of facts collected by the author, which appeared to him to establish, "beyond doubt," that in some places where ague is prevalent pulmonary consumption is comparatively rare. Since the subject has lately been renewed, and has assumed a considerable degree of importance, and Dr. Wells's name has frequently been omitted altogether in connection with it, I have collected the facts as he recorded them into a tabular form. (Table XXXI, p. 605.)

An examination of this table will at once shew, that the presumed facts were not in every instance derived from reliable sources, and also that the inference is founded upon no accurate statistical data. Some of the circumstances are qualified by the facts and statistics comprised in the article "climate" of the present work (p. 508); although the whole of the observations produce a general impression that the opinion entertained by Dr. Wells must have a real foundation. Among the objections to Dr. Wells' view, subsequently brought forward, we find the apparent advantages of marshy districts referred by Dr. Southey to the effect of agues in destroying unhealthy children before they become tuberculous; and Dr. Cookson, of Lincoln, Dr. Hendy, and Dr. Badeley, of Chelmsford, assured Dr. Southey that they could discover nothing like an exemption in favour of such districts. The various exceptions are met in Dr. Wells' paper by many ingenious arguments—thus he accounted for both ague and phthisis occurring in a hilly district, in the neighbourhood of

* On Consumption as opposed to intermittent fever. Trans. Soc. Medic. Chirurg., vol. iii, p. 471. † Idem, p. 517.

low, wet lands, by the inhabitants contracting agues during their visits to the marshy grounds; and for other exceptions, by the absence or presence of the inducing causes of consumption in particular places.

In 1821, the antagonism of intermittent fever and tuberculosis was again advocated by Heusinger, and in 1825 by Hasse, but the idea was repelled by Clark, Forry, and Lawson; and the question was then again allowed to rest for several years.

The controversy was renewed in the French Royal Academy by M. Baudin in 1843, and the whole subject discussed in an Essay on Medical Geography by this physician. Among the facts brought forward in support of the doctrine the following are the most prominent. In the marshy districts of *Africa* phthisis is very rare; at *Bone,* M. Moreau calculated only twelve phthisical subjects in 6,245 sick, and six tuberculous subjects in 250 deaths.* At *Constantine,* where intermittent fever is not endemic, phthisis is very common. Of 952 sick persons in *Senegal,* three-fourths had marsh fever, and there was not one case of phthisis. At *Maurice,* 233 cases of phthisis stand opposed to thirteen of intermittent fever. In the hospital at *Patmos,* of 1,243 fever cases, M. Rouse observed only two cases of hæmoptysis.† The marshes in the neighbourhood of *Zurich* being of late years dried up, endemic fevers have disappeared, but have been replaced by pulmonary phthisis. In the *Delta* of the *Rhine,* at *Rotterdam,* and *Amsterdam,* in all the low parts where intermittents prevail, tubercles are rare. In the neighbourhood of Brussels, where fevers are rare, phthisis is common. These facts are supported by the records of the French and British Armies.

MM. Gintrac, Forget, Genest, and others, disputed altogether the antagonism in question. They explained the infrequency of phthisis in the army, at certain stations where fevers prevail, by the excessive mortality arising from other causes, and they opposed to the affirmative statements, denials, and different statistical results. M. Forget received into the Hospital at *Strasbourg,* 335 cases of intermittent fever to 236 cases of confirmed phthisis. At *Bordeaux,* where the mortality is 28 per 100 from phthisis, M. Gintrac reckoned 153 cases of phthisis to 1201 of intermittent fever; the right bank of the Geronde furnished 105 fever to 7

* Acad. de Med., Séance du 23 Oct., 1839.

† Hist. Med. de l'Armée Française en Morié.

phthisis; the left bank 379 fever to 27 phthisis; Bordeaux itself 387 fever to 100 phthisis, figures which demonstrate, as M. Gintrac believes, not only that there is no antagonism, but on the contrary, that there exists a *parallelism* between intermittent fever and tuberculosis.

Among the opposing circumstances relied on by M. Genest are the facts elicited by an examination of the reports of Major Tullock and Mr. Wilson, on the sickness and mortality of the British Army at home and abroad, contained in the following table :—

TABLE XXXII.

*Cases of Intermittent Fever and Phthisis occurring among the troops admitted into hospital at home and abroad.**

	Intermittent Fever.			Phthisis.		
The United Kingdom . . .	2·	per	1000	6·5	per	1000
Gibraltar	5·	,,	,,	5·6	,,	,,
Malta	7·5	,,	,,	6·	,,	,,
Ionian Islands	132·	,,	,,	5·	,,	,,
Canada	78·	,,	,,	5·6	,,	,,
Nova Scotia	0·8	,,	,,	7·	,,	,,
Bermudas	2·5	,,	,,	8·8	,,	,,
Western America . . .	250·	,,	,,	9·5	,,	,,
Jamaica	85·	,,	,,	13·	,,	,,

A more specific statement of facts was given in 1844 to the French Academy, in a communication from M. Nepple, an eminent physician practising in Lyons.† During 11 years, from 1818 to 1829, M. Nepple practised in the canton of *Montleuel,* of the department of the *Ain.* The department, bounded on the east by the Jura mountains, on the west by the Saône, on the south by the Rhone, and crossed from north to south by the river Ain, is covered by ponds, lakes, and marshy swamps, and is perhaps of all France, the district in which intermittents are most general, and exercise the most baneful influence on the people; the principal town being *Bourg.* The Canton is composed of several districts, some marshy, some healthy. He was struck by the small proportion of cases of phthisis, scrofula and goitre, which the marshy localities presented; their frequency appeared to decrease as the elements of impaludation become more numerous and more general, and in the farms and villages situated in the most impaluded

* From Bennett's Report Brit. and For. Med. Rev., July, 1845.

† Lancet, Jan. 13, 1844, p. 517.

districts he seldom discovered any traces of tuberculization. M. Nepple gives also the experience of other physicians. Dr. Duteche, whose district was much more marshy than M. Nepple's, *had never seen any cases of phthisis or scrofula in those parishes situated in the part of the country in which the ponds are most numerous, and the population most debilitated by intermittents,* and he was convinced that the atmosphere of the district must exercise a favourable influence on the first stages of phthisis. Dr. Pacond of Bourg, during 45 years' practice, did not recollect having seen any cases in the neighbourhood of Montleuel, which invalidate M. Nepple's results—he had no notes of any traces of tubercular diseases in the marshy districts. Dr. Hudelet, physician to the Bourg Hospital, and often called to the parishes in the centre of the marshes, did not remember having seen a single case of phthisis in that part of the country; but the children of the better class of people residing in these localities, when placed in schools not under the influence of marshy emanations, *lose the benefit of that influence,* and sometimes become affected with tubercular disease, *in which case the malady is not arrested by their return to their native place.* Dr. Monfrin, physician to the hospital of *Chatillon-les-Dombes,* the parish not being situated in the most marshy part of the district, states, that pulmonary phthisis is rare—in 400 deaths, comprising those of the hospital, there were only eight by phthisis, one of the eight being a stranger to the country. MM. Rater and Candy, physicians to the Hotel Dieu at *Lyons,* who have practised in the marshy plains of *Forez,* have also noticed the rarity of phthisis in that neighbourhood. Dr. Candy has ascertained that latterly, since many marshes and ponds have been drained, and the wealth of the country has become greater, phthisis has been more frequent. Dr. Jolly remarks on the rarity of phthisis in the marshes of *Arcachon.*

The opposing facts are answered by M. Nepple, by a reference to the great differences which exist in the Medical topography of the different localities in which the question has been studied. M. Forget and Gintrac have taken for the basis of their observations the inhabitants of the hospitals of Strasbourg and Bordeaux, the population of these establishments being of a very mixed character, from very different habitations, and placed under the influence of very different hygienic conditions. In these localities, the physical state of the soil is very different from that of the really marshy

districts, and there are also numerous other morbific causes which modify the fevers generated by the effluviæ. But M. Nepple admits, as Dr. Wells did originally, that the two diseases may develope themselves simultaneously in the same localities, and that the mere accidental intoxication produced by marsh miasmata does not act as a preservative.

"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 odour, 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 maximum of intensity by repeated attacks of intermittent fever. It is in the existence of this oganization, 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 indige-

nous inhabitants is deteriorated, the less frequent do tubercular affections become."

Dr. Helft, of Berlin, has very recently published opposing facts, most of which have already been stated. He relies much upon the coincidence of the two diseases in the marshy districts of the West Indies, and states, on the authority of Dr. Sigaud, that in the Brazils, which are ravaged by fevers, phthisis destroys a fifth of the population. He concludes that the apparent exclusive effects of miasms are owing to the temperature of the air, its uniformity, its hygrometric state, the predominance of winds, and other circumstances. A uniform atmosphere without being too humid, although impregnated with miasms, constitutes the best preservative against phthisis, as in British Guiana where the temperature is very uniform and phthisis is unknown; whereas, in the Antilles, still impregnated with miasms, the heat of the day is replaced by cold and humid nights, and phthisis and agues are both common. He appeals also to atmospheric influences to explain the fact relating to Hyères, which had been made a sort of colony for the consumptive, and was supposed to have become of late less calculated for the purpose, owing to the drying up of the marsh lands; this town is subject to dry, sharp, north-east winds, and too great dryness of the atmosphere is not less injurious than atmospheric vicissitudes.

In Holland, the subject has given rise to repeated discussion, and in 1845, it was brought prominently forward by De Brauw, at a meeting of the Association of Arts and Sciences at Utrecht. The majority of the physicians present, among others, Mulder, Donders, Fillanus, and Arntzenius, expressed themselves very strongly against the reciprocal excluding tendency of these diseases; but a Commission, consisting of De Brauw and Schneenogt, was appointed to investigate the subject in all its bearings. Yet, hitherto, notwithstanding the most zealous endeavours of these inquirers, no definite result has been arrived at. After drawing the attention of the association to the difficulties opposed to a solution of the question, the committee begged to be allowed to limit itself to the premises,—whether a reciprocal exclusion of these diseases had been observed in Holland?—promising to afford a satisfactory solution to this part of the question based on experience.

The following year the Commission expressed its regret, for the

want of interest manifested by the profession at large on the subject under consideration, no more than eleven memoirs having been presented. Of these, four were in favour of the antagonism and seven against it. De Brauw sided with the latter; while Schneenogt did not express any decided opinion, but showed by his statistical reports, that 8,723 patients had been received in the hospital at Amsterdam during the last seven years; of whom 381 were affected with tuberculosis, and 2,326 with intermittent fever; 282 of the phthisical patients escaped intermittent fever, while 99 were attacked by it.*

A totally new theoretical view of this vexed question has been recently taken by Dr. Hirsch, founded upon the development of electricity on the surface, and Dr. Eisenmann's discovery of a source of atmospheric electricity in the strata, of the earth.† The most extraordinary circumstance is that Dr. Hirsch arrives, apparently from an analysis of facts, to a diametrically opposite conclusion to that of Dr. Wells, Dr. Nepple, and others, on the antagonism of the two diseases. After describing the production of intermittents by atmospheric electricity, he states:—

"In respect to topographic antagonism, we shall find that a great proportion of the conditions favorable for the production of pulmonary phthisis are not the less so for the production of intermittent fevers; and arrive, *à posteriori*, at the conclusion—that the same countries where intermittent fevers are endemic, under the influence of atmospheric conditions, already described, ought to be at the same time, prolific in scrofula, and consequently in pulmonary phthisis. If we examine the facts, we not only find the law by virtue of which intermittent fever or pulmonary phthisis ought to be excluded topographically, not confirmed, but—

"1. That countries where intermittent fever abounds present also pulmonary phthisis with an endemic character, and often in such a manner that the increase of the one follows directly as the increase of the other. 2. That a great many places, where endemic phthisis is unknown, are equally exempt from intermittent fever—the Cape, for example. 3. That certain places, especially certain large towns, have phthisis to a great extent, without being foci for intermittent fever; though this is an exception to the general rule; it is however explained by the particular conditions

* Von Deen's Arch. iii, 3, 1850.

† The Institute, vol. ii, p. 234, from Zeitschrift für die Gesammte Médicin., 1850.

in which the individuals are placed (nourishment, habitation, habits, &c., &c.) 4. That certain countries have endemic intermittent fevers, without the occurrence of phthisis. This is also an exception to the general rule; but it may be admitted that intermittent fevers are then produced by other circumstances than the atmospheric influences cited. I may here refer to the presence of these fevers in volcanic places; thus, for example, in the Maremmes, where, according to Salvagnol, phthisis is very rare" (p. 525).

The contradictory character of the alleged facts is here evident; and the theory is unsupported by any evidence.

It should be also stated that the American writers generally, deny the antagonism, as respects the remittent and malignant fevers to which the climate of North America is so proverbially subject.

The existence of this antagonism in the African race is beyond any dispute. We have already described their remarkable susceptibility to tuberculosis in all climates exept their own (p.532). Their exemption from fever and ague is equally remarkable. The statistics of the British Army, at stations where fever and ague prevail, pre sent twenty times more intermittent fever in the whites than in the negroes; while, as already shewn, the latter are, to a great extent, more subject to phthisis. The Indians, according to Dr. Ischudi, are more subject to fever than the whites, and the whites than the negroes, who work in marshy grounds with impunity for years together.* In Senegal the negroes are, again, exempt from ague but subject to phthisis, "which destroys 1/15th of the natives, and scarcely six per cent. of the Europeans." † At Rio Janeiro the African population have a similar immunity from intermittent fever.‡ A similar fact presented itself in the Niger expedition in 1841; of 158 negroes, 11 only had fever, while of 145 European sailors, 130 were sick, and 40 died. A similar immunity against fever and a similar susceptibility to phthisis, was observed in a regiment of Hottentots at the Cape of Good Hope. In Algeria, Dr. Guyan found phthisis making more ravages among the native Moors and Jews, than among the Europeans, who, on the contrary, were frequently destroyed by intermittent fevers. Thus the an-

* Archives Générales, tom. xvii, p. 196—1848, from Zeitzschrift für Jesamente Medicine, f. 360, liv. 3.

† Dr. Thevenot, Traité des Maladies des Europeans au Senegal. Paris, 1840.

‡ Dr. Talisant Discorso sobre as molestias, 1835.

tagonism of phthisis and intermittent fever in the different races of man, in marshy countries, appears to be incontestible.

The facts may be thus generalized :—The natives of certain marshy countries and districts, particularly negroes and people of colour, appear to acquire a diminished susceptibility to the action of miasms as compared with strangers to the country or district, and especially with whites and Europeans; but with this diminished susceptibility to the action of miasms they become more susceptible of the condition of the blood which constitutes tuberculosis, as shewn by their increased liability to phthisis. Europeans and foreigners, in these districts, present a high degree of susceptibility to the action of miasmata, and a diminished susceptibility to the causes of tuberculosis.

I have considered it expedient to record this controversy in full, with the principal facts relied upon in support of the different views entertained, because I regard it, theoretically, as one of considerable interest. Before stating the conclusions to which I am led, it is important to furnish the reader with the analyses before me of the blood in intermittent fever.

The blood of four persons residing in malarious districts and suffering from intermittent fever, was analysed by Cozzi; the following are the results :—

	1	2	3	4	AVERAGE.
Water and salts . .	737·67	705·49	732·45	809·17	= 746·19
Fibrine	2·20	2·06	2·29	1·96	= 2·12
Fat	·15	·21	·13	·16	= ·16
Albumen . . .	48·71	56·61	47.59	53·10	= 51·50
Blood corpuscles . .	211·27	235·63	217·54	135·61	= 200·01

No. 1. A soldier with severe intermittent fever, and considerable enlargement of the spleen and liver.

2. A man with a quartan ague; the spleen and liver much enlarged.

3. An artillery man, who had been five years stationed in a malarious district; intermittent fever, with slight enlargement of the liver, and extraordinary hypertrophy of the spleen.

4. Fever for a long time; cynanche tonsillaris; spleen enlarged, and very painful.

Bile pigment was observed in the blood; in three of the cases there was an excess of cholesterine and scarcely any phosphates; in one case (No. 3), these salts were abundant, while no cholesterine was found.*

* Simon's Animal Chemistry, vol. ii, p. 510.

I have not inserted the analyses of twelve cases by Dr. Fricke (lib. cit. p. 30), because they appear to be instances of that accidental impaludation, which it is admitted on all hands, does not operate as a preservative; the duration of the disease in the majority having been only a few days, and in none more than a few weeks.

As far as chemical analysis goes, the facts shew that the state of the blood, in confirmed and aggravated intermittent fever, is the very antithesis of the state of the blood in tuberculosis, in several important particulars; and more especially, that the proportion of albumen is greatly diminished, and that of the red corpuscles is uniformly, and to a very considerable extent, increased; two circumstances which are in direct opposition to the state of the blood in tuberculosis.

Before closing this interesting subject there is one other point which ought not to be omitted. Of late years, some very good reasons have been given for attributing the effects, usually called malarious, to the action on the system of sulphuretted hydrogen gas.* If this opinion have any foundation in truth, the antagonism of tuberculosis and ague means, that sulphuretted hydrogen produces an effect upon the blood, incompatible with the tuberculous transformation and the formation of tubercle.

After a careful investigation of all the facts before me, I arrive at the following conclusions :—

1. That the morbid condition of the blood produced by the malaria or poison of intermittent fever, is totally distinct from the morbid condition of the blood which attends tuberculosis.

2. That the intense and permanent poisoning of the blood by malaria, renders it insusceptible of the morbid condition which constitutes tuberculosis.

3. That a slight degree of poisoning with malaria, or the casual occurrence of intermittent fever, does not render the blood insusceptible of tuberculosis; and that its degree of insusceptibility bears some relation to the degree of impaludation.

4. That individuals affected with tuberculosis in a high degree, either with or without the manifestation of local disease, are not cured by residing in a malarious district.

5. That the blood of individuals poisoned by malaria, recovers from the effects of the noxious influence after removal from the ma-

* Dr. Gardener in the American Journal of Medical Science. April, 1843.

larious atmosphere, and then, however complete the insusceptibility to tuberculous disease may hitherto have been, the susceptibility returns, and tuberculosis actually occurs on exposure to the inducing causes.

6. That, in accordance with the position laid down at (4), individuals so acquiring tuberculosis are not cured by a return to a malarious atmosphere.

7. That in Great Britian, and many other countries, where complete impaludation of any very extensive district is not now likely to occur, it is not probable that the antagonistic influence of the paludal poison will exert any great effect on the amount of tuberculosis occurring in any district.

8. That it is probable the fevers known as intermittent, remittent, or continued, occurring in different countries, have their origin in different kinds of poison received into the blood, some of which may produce antagonistic effects, and some not; and that, at present, this appears to be the only plausible conjecture by which the contrary statements contained in this section can be reconciled.

9. That the beneficial effects, as far as the tuberculous state of the blood is concerned, of a residence in a malarious atmosphere before the manifestation of local disease, or in its incipient stages, is highly probable; but, looking to this effect in the medical statistics of large numbers of individuals, as of troops serving at malarious stations, it cannot be held that the human race would gain anything by poisoning the blood with malaria to a sufficient extent to cure tuberculosis.

There is, perhaps, no more important branch of theoretical and practical medicine than the one embraced in the last Section. It includes most of the important questions relating to the pathology of the blood. From the period that Bonetus laid the foundation of pathological anatomy, by the publication of the "*Sepulchretum,*" 173 years have transpired; and nearly a century since Morgagni promulgated his work—"*De Sedibus et Causis Morborum,*" and the accumulated labour of innumerable observers, throughout this long period, has been required to attain the present degree of perfection in that part of pathology which relates to the solids. Little more than twelve years has elapsed since the attention of the pro-

fession has been seriously directed, in this country at least, to the pathology of the fluids. If we have made but small progress this is attributable to the inherent difficulties of the subject; but in truth, there is no reason to be discouraged, important facts have already been developed, and the investigation can scarcely yet be said to be fairly entered upon. In our autopsies, diseased organs are weighed, dissected, and examined microscopically, and they are carefully preserved in our museums, but the fluids of the diseased body are still either totally disregarded, or examined very cursorily or very partially.

CHAPTER VII.

OF THE FORMS AND VARIETIES OF TUBERCULOSIS.

In the present day, the nosological branch of medical science may be described as a dead letter. Although every part of medicine is enriched with countless facts, and these are daily augmenting, we cannot be said to possess any code of principles, or any system by which they are arranged and combined. I believe the time must come, when the accumulated mass of details will coerce us into a more systematic scheme of medical philosophy. However this may be, the extent and importance of the generalization of facts in this work, under the single denomination—"Tuberculosis," renders it necessary to say a few words on the nosological synonyms or analogies of this term, in order that there may be some clue to the positions occupied by the forms or varieties of tuberculosis, in the systems which formerly prevailed.

SECTION I.

THE NOSOLOGICAL RELATIONS OF TUBERCULOUS DISEASES.

Previous to the very general cultivation of pathological anatomy, and the discovery of the physical aids to diagnosis, cases, characterized chiefly by emaciation and debility, and terminating fatally without any evidence of organic or local disease, were of frequent occurrence. These cases were regarded as general diseases or depraved habits of body, and were arranged by the nosologists, as by Sauvages and Cullen, in the class Cachexiæ. They were referred by these writers, and by Linneus, to the orders macies, marcores, and emaciantes, and the genera and species were distinguished from each other by the presence or absence of fever, and according to the supposed causes of the emaciation and debility. The progress of pathology and diagnosis, in a succeeding age, no doubt contributed to diminish the number of instances, wherein general disease proceeds, to any great length, without giving evidence of some local organic affection, and the almost constant occurrence of local manifestations, before diseases become

the object of medical investigation and treatment, now induced the teachers of medicine to localize every derangement of health, to place its primary seat exclusively in the more solid organs, overlooking the blood, and almost totally to discard the idea of general disease. The further progress of science has, however, tended to convert the order of sequence, and, with the aid of micro-chemical analysis and minute pathology, the reality of morbid conditions of the blood has been demonstrated,—and we have learned to regard the disease of the organs, in a vast proportion of cases, as secondary to the changes produced in the blood. It is now manifest to the most cursory observer, that, in many instances, the causes of disease act primarily on the blood, and that the universality of this fluid as respects its presence, and its importance in the economy, renders every modification it may undergo the source of a very general derangement of the whole economy, and the most common origin of the functional and structural changes which constitute disease.

None of the nosologists appear to have specified the blood as the primary seat of the morbid change in any disease, and the idea at present attached to the term—"Tuberculosis," is not to be found in any of their systems. The numerous forms of disease, so clearly indicated by the special pathological anatomy of tuberculosis as derived from a common origin, and from their history and symptoms, as being only various local manifestations of one and the same disease, are accordingly scattered throughout their systems, and are to be found, not only in different genera, but in different orders and classes, an unequivocal proof that these systems are totally inconsistent with the present advanced state of pathology.

In illustration of these remarks, it will only be necessary to refer to one or two systems which have enjoyed the highest degree of fame, or have been propounded by men of the greatest genius.

Tuberculosis, in its various forms, is comprised chiefly in the following genera and species interspersed in various parts of Dr. Cullen's nosological scheme:—

Cl. I. Pyrexiæ.—*Ord. I. Febres.*—Gen.—Hectica:—Including the Hectica Scrofulosa, and in part the feb. infantilis. Admitted to be symptomatic.

Ord. II. Phlegmasiæ.—Gen. xxiv. Arthropuosis:—Including the lumbago psoadica; l. apostematosa; l. ab

arthrocace; Ischias ex abscessu—of Sauvages; and the Morbus Coxarius of De Haen.

Ord. IV. Hæmorrhagia.—Gen. XXXVI.—Hæmoptysis. H. phthisica or phthisis, of which there are two species—phthisis incipiens, and phthisis confirmata; the latter including p. scrofulosa; p. exanthematica; p. a vomicâ, &c. from Sauvages.

Cl. III. Cachexiæ.—*Ord. I. Marcores.*—Gen. LXIX.—Tabes. Sp. Tabes purulenta; including the t. a vomicâ, and the t. ulcerosa of Sauvages. Sp. Tabes scrofulosa; including the t. glandularis; t. mesenterica; scrofula mesenterica of Sauvages.—Gen. LXX.—Atrophia. Doubtless cases of wasting without fever, set down as idiopathic atrophy, were often, particularly in infants, cases of tuberculosis.

Ord. II. Intumescentiæ.—Gen. LXXVI.—Hydrocephalus.

Ord. III. Impetigines.—Gen. LXXXIV.—Scrofula; s. vulgaris; s. mesenterica of Sauvages, &c.

Cl. IV. Locales.—This class comprises many of the local scrofulous affections; as Gen. XCIII. Amaurosis Scrofulosa of Sauvages. Gen. CXXXVII. Lupia. Gen. CXL. Hydarthrus—white swelling.

In Dr. Young's nosological system, consumption is made a species of hectic fever, which is found in Class II, consisting of diseases of the sanguiferous system; the hectic fever includes Dr. Cullen's two species of phthisis, as also glandular affections. Scrofula, which is defined as a "swelling of the glands or bones from a general disease," is placed in a totally different part of the system—Class IV, or structural diseases—and in the order "Eruptions." Hydrocephalus is found partly in Class I, consisting of nervous diseases, and partly in Class IV.

The genera atrophia and tabes, in Dr. Cullen's system, the one comprising diseases of emaciation and debility without, and the other with hectic fever, belonging to the order marcores, in which the whole body is emaciated; and the class cachexiæ, defined as a depraved habit without primary fever or nervous disease; are the most obvious nosological positions of tuberculosis. To these genera were referred all those exceptional instances in which the disease terminated without a deposit of tubercle or any local affection; and also the more frequent instances, in which, although tubercle was deposited, there was no means of determining its existence,

and even many of the cases in which the constitutional disease was obviously attended with local disease; thus, the genus tabes comprises cases of emaciation and debility accompanied with ulcerations and abscesses in scrofulous constitutions.

Cullen's genus atrophia comprises the atrophia or marasmus of Sauvages, Linneus, and Vogel. The definition of atrophia given by Sauvages is more closely applicable to tuberculosis than that given by Cullen, inasmuch as he regards it as a disease of debility, in which the body or a part of it is, in a marked degree, emaciated without fever, and the emaciation of tuberculosis is perhaps after all only partial (p. 356); the hectic fever, however frequently it supervene before the disease reaches its termination, not being essential. A majority of the cases of tuberculosis, in their earlier stages and slighter degrees, possesses the characteristics of simple atrophia, but they pass into the genus tabes. The latter comprises tabes mesenterica and tabes a vomicâ, which are but modifications of tuberculosis. No doubt the cases of simple decline (Young), which I regard as uncomplicated tuberculosis, are comprised in the atrophy of Cullen and the atrophy or marasmus of Sauvages, and the same cases after fever had set itself up in the genus tabes. Many of the pathological lesions which have been described in this work, and are the basis of varieties or modifications of one species of disease, were created by the systematic nosologists into distinct genera and species.

To pursue this subject further would be futile. The inconsistencies, as illustrated above, are so obvious, that it is perfectly conclusive a new and totally different nosological arrangement must be devised, upon a more natural and more rational basis, before our medical doctrines can assume the dignity of a philosophical system.

SECTION II.

THE NATURE AND ORIGIN OF THE DIFFERENT FORMS OR VARIETIES OF TUBERCULOSIS.

We have endeavoured to establish, in former parts of this work, that the general depraved habit of body, or "cachexia," which comes under the designation—"tuberculosis," depends upon a morbid condition, and is strictly an idiopathic disease of the blood. We have proceeded as far as organic chemistry enables us, in defining the character of the disease, and in determining the organic constituents involved in the morbid process; but the blood

is a very complex fluid,—its proximate principles have many elements, are possessed of very high combining powers, and comprise the compound radicals of many series of transpositions; it may, accordingly, remain a question, whether the morbid constituents, in the various forms of disease included in the term, may not differ so far as to constitute different species. If the disease be essentially a change in the molecular constitution of one or more of the proximate principles, it is also easy to conceive that these may be subject to modes and degrees of the morbid process. Thus, some pathologists have asserted, that scrofula and phthisis are different diseases, at the same time admitting, that there is some unknown relation subsisting between them. Others affirm that they are one and the same disease. Lebert states, that we are not in a condition to affirm whether or not there be a scrofulous material differing from tubercular matter; and, accordingly, that we are not at present able to separate the disease into species, much less to lay down any definition of distinct species. It appears to us that there is one definite, although at present not strictly definable, constitution of the blood, upon which all the manifestations of tuberculous disease depend; and that the pathological lesions appertain, uniformly, to the same proximate or organic principles,—that in both, "scrofulosis" and "tuberculosis," they depend upon the same causes, and are attended by changes of nutrition and succeeded by deposits at all times essentially of the same nature. Upon that foundation the present treatise has been written.

Inasmuch as that tuberculosis frequently pursues a very different course when its local manifestations are developed externally, as compared with its course when they occur in internal organs, and as many pathologists of the highest reputation have inferred from this, that these two groups of affections are totally different, it becomes necessary, in relation to the forms and varieties of tuberculosis, to refer to:—

The analogies and differences which subsist between phthisis and scrofula, with a view to the definitive settlement of a question upon which the import of the word—"Tuberculosis," and the comprehensiveness of its pathology, depend.

Using these terms in the general acceptation, the one, according to the view here taken of tuberculosis as a disease of the blood, is a distinct and most important variety or form, and the other a series of varieties or forms, of tuberculosis.

The word "scrofula" has been employed in various senses. Sometimes it is made to designate a morbid condition of the constitution, acting as the cause of one or of various local diseases.* It scarcely need be said, that I abandon its employment in this sense. At other times it is made to designate some local affection, as a peculiar form of ophthalmia, or a peculiar affection of the knee-joint, grafted upon an unknown morbid state of the constitution. Various degrees of latitude or limitation have been given to the local affections thus designated as scrofulous. Mr. Phillips has adopted a swelling of the lymphatic glands as his diagnostic sign of scrofula. This, to me, is a new limitation. According to the view I am led to take in this investigation, numerous local affections, occurring in the subjects of this morbid state of the constitution, are properly called scrofulous; as swellings of lymphatic glands, affections of the bones and joints, cellular abscesses, ophthalmia, and the like; but their scrofulous character is wholly dependent upon the general disease. Tumid glands, caries of the bones, and inflammations of the joints, are not scrofulous in otherwise healthy subjects. Thus scrofula is some local manifestation of a diseased state of the constitution.

But the deposition of tubercle in particular organs also takes place, according to universal assent, in a particular condition of the constitution. This I have referred to an idiopathic disease of the blood, which I have designated and described as tuberculosis. Tubercle is a local manifestation of tuberculosis.

The whole question then is—whether the disease of the blood which leads to the deposit of tubercle, and that which gives the specific character to scrofulous affections, is essentially the same? I believe it is, and that the domains of pathology contain irrefragable proof thereof.

The chemical and physical details, already given, of the state of the blood in scrofula, and in the predisposition, and the incipient stages of local tubercular diseases, to a certain extent establish this identity (p. 4). The peculiarities of the constitution which characterize the predisposition to tuberculous affections and scrofulous affections, respectively, establish their identity (pp. 20, 26 et pas). It is true, that some of these peculiarities appertain more especially to one form, and others to another form of the disease; but,

* "De l'Analogie et des Différences entre les Tubercules et les Scrofules." Par Dr. A. Legrand. Paris, 1849.

as a whole, it is the same predisposition which tends both to scrofula and tubercle. The signs and symptoms of general disease, when that supervenes on tuberculous and scrofulous affections, are essentially the same (Ch. II, p. 60). Scrofula and tubercle frequently co-exist in the same individual, and of fifty individuals dying of affections denominated "scrofula," forty are affected with internal tubercle (p. 366). Tubercle is met with in unequivocally scrofulous local diseases (Tab. XVI, p. 404). In tuberculous families, some individuals are affected with scrofula, and others with tubercle; and scrofulous parents frequently have tuberculous children, and tuberculous parents more frequently scrofulous children; the identity of the two diseases is completely established by the facts of hereditary transmission (p. 373, 378, Tab. XIV., &c.) The local products of scrofula and of indisputable tubercular disease, have the same anatomical elements, and there are many strict analogies in their chemical composition (pp. 114, 118). Both are subject to the same metamorphosis, of softening and cretification; and, in the words of Rokitansky, whose opinion is said to be founded on an experience of from thirteen to fourteen thousand cases, "the tuberculous and the so-named scrofulous ulcers are entirely similar, not only when they occur in the same organ, but when they occur in different organs, and affect different structures, as in scrofulous ulcers of the skin, and tuberculous ulcers of the intestines; and the same is the case with respect to their cicatrices. Both occur in the same organ, sometimes with and at other times without the symptoms of inflammation, and are very often found associated. The same substance will often be called tubercle or scrofula, according as it occurs in the lungs or in the bronchial glands."

This statement, of the principal facts and analogies which establish so conclusively the identity of the two diseases, would not be regarded as complete if we omitted to notice some of the differences which have been relied on in support of the contrary view. Many of these are explained away by the foregoing facts and references. The statement frequently made, that scrofulous individuals are eminently liable to skin diseases, and tuberculous subjects almost exempt, has been qualified in a former part of the work (p. 167). In so far as the statement is correct, it admits of explanation upon the principle of identity. The skin is more susceptible of disease at the period of life during which the blood is most frequently

tuberculous, in that degree only, which constitutes the predisposition to, and lays the foundation of, chronic irritation and ulceration, without a deposit of tubercle; and again, the facts of pathology are very strongly corroborative of the common opinion, that the occurrence of external tuberculous affections, cutaneous disease included, is a cause of the non-deposition of tubercle in the internal organs. Another argument, founded on the assumed curability of scrofula and non-curability of phthisis, has been advanced; but, on the ground that the latter is an advanced stage of the former disease, the argument is neutralized; and, by the new proofs brought forward daily, establishing the curability of phthisis, it is totally invalidated. Another circumstance which has been greatly relied on, by those who deny the identity, is the occurrence of scrofula in childhood and early youth, while tubercle belongs, more especially, to a more advanced period of life, but the statistical facts contained in this treatise, prove this also to be an erroneous assumption; in the face of the recorded fact, that in the autopsies of 525 children under 15 years of age, internal tubercle was found in 314 (p. 410)—and of the facts contained in the Registrar General's Report of the deaths occurring in England and Wales, during the year 1847 (Tab. XIX), 671 individuals above 30 years of age having died in that year from scrofula,—we believe that *age* can never again be urged as a ground of essential or specific distinction.

Lugol's authority, founded upon his vast experience, ought not to be despised. He regards scrofula as an hereditary affection of the entire system, which may result in diseases of every organ and tissue; and the production of tubercle as the maximum of that affection. Owing to the modifications which take place in the local vitality of different parts of the body at different periods of life, the development of tubercle occurs in different organs.*

The special pathological anatomy studied as a whole, as well as the etiology, prove incontestably that scrofulous affections and tubercular affections, regarded as local diseases, have a common origin. At the same time, the full force of the proposition, that external scrofula, in its seat, form, history, progress, and results, differs very considerably from those forms of disease characterized by the internal deposit of tubercle, cannot be questioned.

* "Récherches et Observations sur les Causes des Maladies Scrofuleuses." Paris, 1844.

It is not held that the condition of the blood in the "purulent diathesis of scrofula," and in the "tuberculous cachexia of phthisis," for instance, is, at the period of the occurrence of these forms of disease, identically the same; but that the whole of this series of maladies has its origin and essence in a pathological condition of the same nature. The malnutrition constituting the predisposition—the general disease, at whatever period of life it may present itself—the local effects—have all a similar starting-point in the disease of the blood. The blood itself, like the more solid structures of the body, is subject, even in health, to modifications in its composition and vitality, according to sex, age, temperament, and other circumstances. Physiologically, the blood undergoes progressive changes in infancy, juvenescence, mature age, and senility. Tuberculous blood, besides differing as to the degree in which it is tuberculous, is subject to all the same modifying circumstances. Hence, when deviating very slightly from its healthy state, it may lay the foundation for very partial irregularities of development in the fœtus, and a very slight predisposition to disease, and it may never, under favourable circumstances of extra-uterine life, declare itself as actual disease; or, being more radically and decidedly diseased, its effects may be such as to destroy the embryo at any period of its development. Hence, also, tuberculous, to a certain degree and at a certain age, as in juvenescence, it may yet be sufficiently healthy in its constitution, and endowed with sufficient vitality, to produce a nutritive blastema for all the tissues; but, at the same time, its condition may be so much below the standard of perfect health, that when, for instance, a part is subjected to the causes of inflammatory action, there is a morbid tendency to exude pus of bad character; the tissues themselves, from their debilitated structure, being extremely liable to ulceration. In a few words; the tuberculous blood of juvenescence may act as a predisposition to the suppurative and ulcerative affections which constitute so considerable a portion of those forms of tuberculous disease which are classed under the denomination of scrofula, and this same tuberculous blood may have its vitality so much diminished, and its qualities deteriorated to such a degree, even in infancy, as to be prone to exude, in one or more organs, an absolutely innutritious blastema—a blastema in which organic cells are not formed at all, or are imperfectly formed—a liquor tuberculi. Or, under the modifications resulting from age, the cessation of growth and

development, or changes in the habits of life, or hygienic circumstances, the same tuberculous blood which in early life, would produce scrofula, at puberty inclines to tuberculization. "Scrofulosis" being a disease of most frequent occurrence in childhood, and "tuberculosis" at mature age, even if true, would be no argument against the essential identity of the two; it would only show that the different periods of life determine the development of the disease in a different stage and under different forms.

This point being as we conceive definitively settled, we find, that even in internal and external tuberculous affections, respecting which a clearer line of demarcation is observed than in any other view that can be taken of the disease, there is no ground for specific distinction. But the forms, varieties or modes which it affects, are sufficiently numerous, and often very distinct. These are not founded solely upon the external or internal development, but upon innumerable accidental and incidental circumstances; upon the special causes by which local disease is produced, and even upon the particular tissue or organ chiefly affected.

This subject is well illustrated by Dr. Madden (lib. cit. p. 60)— "The varied external circumstances in which individuals are placed at different periods of their lives; the peculiar morbific influences to which they are exposed; and the special modifications of functional activity and organic development which belong to the two sexes, are, I apprehend, quite sufficient to account for the observed discrepancies. And the same explanation applies, and with equal force, to the relative geographic distribution of scrofula and phthisis; the one or the other form of the disease is most prevalent in certain countries, or in certain districts of the same country, as a consequence of peculiar exciting or predisposing circumstances. Take, by way of example, two children of the same family, both inheriting from their parents a radically defective constitution. The one, a boy, is sent to school, and engages with his companions in all manner of athletic exercises. He receives an injury upon his knee; inflammation follows; the latent disease, thus roused into activity, becomes fully developed, and he sinks, exhausted by the discharges and the constitutional irritation from his scrofulous joint. The other is a girl, and not exposed to the same sources of danger; but she is confined much to the house in the acquisition of certain so-called necessary accomplishments, and exposed to the frequent sudden alterations of

temperature which are unavoidable in following out the amusements of fashionable life; and thus her lungs, ill-defended, because sufficient warm clothing is not worn, become at last affected, and she dies of phthisis. Is not the disease identical in both, though its manifestations are different? I had lately under my care a lady, who lost an elder sister in pulmonary consumption. She suffered from glandular abscesses in the neck in childhood, had suspicious symptoms in the chest, was the subject of hip-disease, and manifested many other evidences of the strumous diathesis. A brother, exposed to peculiar influences in a warm climate, was affected for a considerable time with non-syphilitic ulceration of the back of the throat, and caries of the turbinated bones of the nose. Is it possible to deny the identity here? "

After the degrees and varieties of morbid action resulting from the imperfection of the nutritive functions, and constituting the group of diseases hitherto denominated scrofula, and other degrees and varieties resulting from the formation of an absolutely innutritive material, acting as a foreign body, and constituting another group known as tubercular, the various modes which the disease assumes, are most obviously determined by the *seat* of the local outbreak. According to the organs or structures affected, particular trains of symptoms set in, as exemplified by disease in the brain, lungs, glands or joints. Hence the various tuberculous affections; as mesenteric decline or pulmonary consumption; Pott's disease or white swelling; ophthalmia or hydrocephalus; each of which has its peculiar history and its appropriate symptoms; and by its supervention, for the most part, overrules the original disease, and determines its results.

The local manifestations of the disease, the forms which it assumes, and its duration, progress and termination, are also determined by the age, sex, constitutional state at the period when any cause of local disease is applied, and especially by the periods of functional activity of different organs. A most important element also in relation to the seat and forms of tuberculous diseases is the hereditary transmission, not only of the liability to the general disease, but of a liability to the particular local manifestation; some children are not only hereditarily predisposed to tuberculosis, but, by the structure of the lungs and the conformation of the chest, they are hereditarily predisposed to phthisis; or by the structure of the brain and the conformation of the skull, to

hydrocephalus. Thus, when the children of tuberculous parents, or children nurtured anti-hygenically, so as to acquire a predisposition, are subject to blows on the head, difficult dentition, and other causes of cerebral excitement, tubercular meningitis, with or without the deposit of tubercle, is liable to develope itself, and, where the tendency to head disease prevails, may occur in several children of one family from very trifling exciting causes, forming a very important form or variety of the disease.

One very marked form of the disease is found, probably, in its extreme degree, as exhibited in Cretinism. Almost all writers have regarded this as a form of scrofula, and its symptoms are all indicative of malnutrition of the same nature as in tuberculous diseases generally, and therefore depending upon the same kind of morbid hæmatosis. This has been regarded as a "disease of personality," because all the psycho-physical relations are disturbed and even abolished. It exhibits the highest degree of idiocy with the greatest bodily degradation; is hereditary and congenital; occurs both endemically and sporadically over the whole surface of the globe, although unequally distributed. It is particularly endemic in narrow vallies, the defiles of great mountain ranges, especially on the shady sides, and in other damp localities. Not only are the symptoms identical with those which constitute the tuberculous habit in the highest degree, and the causes apparently the same, but the remedies which have been found successful are the same, as, for instance, pure mountain air, cod-liver oil, and iodine.

For the study of the origin of varieties we must refer to the summary of the first chapter (p. 51), and to the chapter on the special pathological anatomy. It is not the intention of this work to proceed further into the causes of these local developments and various forms of manifestation; the particular histories of the diseases which they give rise to occur in the various systematic treatises and monographs extant; my principal object here is to present a general view of the comprehensiveness of the term *tuberculosis;* and to exhibit, in juxta position, its more important distinctions.

Synopsis of the principal forms of tuberculosis; intended as the basis of an arrangement of tuberculous diseases in any future system of nosology; and in the interval, as an assistance to the practitioner in the study of the correlations which subsist between each and all the varieties.

TUBERCULOSIS OF THE DERMIS AND SUB-DERMOID TISSUES.

Tuberculous (scrofulous) impetigo; eczema; acne; herpes; elephantiasis? &c. (p. 162).

Tuberculous inflammation of the meibomian glands (*Hordeolum*).

Tuberculous (scrofulous) abscess; ulcer; hospital gangrene (of the French); abscès froid (of the French) (p. 163).

Tubercle in the skin and sub-dermoid tissue (Sir P. Crampton, p. 168); encysted (*adventitious glands.* Wiseman, &c., p. 168).

Tubercular lupus (Baudelocque, p. 163).

Tubercle in the meibomian glands. (Lebert.)

TUBERCULOSIS OF THE MUCOUS AND SUB-MUCOUS TISSUES.

Tuberculous hypertrophy of the lips; tonsils; &c.

Tuberculous congestion—chronic inflammation—erosion, ulceration—of the pituitary membrane (*scrofulous ozœna*); of the tongue (Dr. Cumin, p. 177); of the mouth generally (*aphthæ*); of the mucous membrane of the stomach or duodenum (*strumous dyspepsia?*); of the larynx; bronchiæ; intestines; bladder and other urinary surfaces; vagina (*leucorrhœa,* common in children); &c. p. 189.

Tubercles in the larynx, primary? (*laryngeal phthisis*); in the bronchiæ, primary? (*bronchial phthisis*); in the intestinal canal, primary (*intestinal phthisis*); in the urinary and genital organs, p. 186, &c.

TUBERCULOSIS OF THE SEROUS AND SUB-SEROUS TISSUES.

Tuberculous chronic pleuritis; pericarditis; arachnitis (*chronic hydrocephalus*); peritonitis; vaginitis (rare); p. 191. —adhesions—effusions.

Tuberculous acute pleuritis, rarely primary; peritonitis, rarely primary; arachnitis (*acute hydrocephalus*).

Tubercles in the pleura, primary? (*pleuritic phthisis*, Fournet, p. 194); pericardium—if not occurring primarily constituting the prominent disease, and destroying the patient before tubercles are fully developed elsewhere; p. 200—peritoneum, primary (*peritoneal phthisis*); arachnoid, primary (*acute hydrocephalus. Meningeal apoplexy*) (p. 217).

Tuberculous ulceration of the pleura; peritoneum—perforation.

TUBERCULOSIS OF THE LYMPHATIC GLANDS.

Tuberculous hypertrophy of the external glands (one of the most frequent forms of external development—*scrofula*); of the mesenteric glands (p. 240).

Tuberculous inflammation, for the most part chronic, of the external glands ("*scrofula*" of various authors); bronchial glands; mesenteric glands; &c.

Tubercle in the external glands (only recently recognized as one of the most frequent forms of *scrofula*); bronchial glands, primary (*bronchial phthisis*, much more frequent in children than in adults); mesenteric glands (*tabes mesenterica, mesenteric phthisis*).

TUBERCULOSIS OF THE NERVOUS CENTRES AND NERVES.

Tuberculous chronic inflammation of the brain or cerebellum—most frequently coinciding with extensive effusion into the ventricles, with or without chronic meningitis, (*chronic hydrocephalus*).

Tuberculous acute inflammation of the brain or cerebellum—most frequently coinciding with acute meningitis (*acute hydrocephalus*); with abscess (*scrofulous abscess of brain*).

Tubercle in the brain, cerebellum or appendices—— *a*, encysted; *b*, infiltrated; *c*, numerous miliary; *d*, one, or at most few; *e*, with œdema or white softening, p. 246; *f*. with red softening, p. 246; *g*. with hæmorrhage (*tuberculous cerebral apoplexy*).

Tubercle in the medulla spinalis (very rare), p. 253.

Tubercle around the nerves—*a*, with softening and loss of continuity, p. 254.

(*Cretinism.*)

TUBERCULOSIS OF THE LUNGS.

Tuberculous chronic pneumonia characterized by grey hepatization, p. 265.

Tuberculous acute pneumonia, p. 266.

Lobular or vesicular pneumonia, p. 264.

Tubercle in the lungs (*tuberculosis or phthisis pulmonalis*) —*a*, from a simultaneous or progressive deposit of tubercle remaining crude for a considerable length of time (*chronic phthisis*, Latham); *b*, from successive crops of tubercles ripening or being expelled at longer or shorter intervals, with intervals of comparative health (*chronic phthisis*, Latham); *c*, complicated with pneumonia (*mixed phthisis*, Latham); *d*, complicated with pneumonia and bronchitis, and running its course very rapidly (*acute phthisis*—vulgo, *galloping consumption*); *e*, internal deposit without symptoms (*latent phthisis*, Louis, Legrand, and others); hæmoptysis; emphysema; œdema of the lung; gangrene; &c. &c.

TUBERCULOSIS OF THE HEART.

Tuberculous (scrofulous) inflammation and suppuration of the heart (Wiseman, Lloyd).

TUBERCULOSIS OF THE LIVER.

Tuberculous hypertrophy (p. 295).

Tubercle in the liver (p. 298).

Fatty liver.

TUBERCULOSIS OF THE KIDNEYS.

Tuberculous (scrofulous) inflammation, suppuration and abscess (p. 305).

Tubercle in the kidney; tubercular cysts (p. 309).

Tubercle in these and the other viscera rarely, if ever, primary.

TUBERCULOSIS OF THE MALE URINARY AND SEXUAL ORGANS.

Tuberculous hypertrophy of the prostate gland (Lloyd, lib. cit., p. 108).

Tuberculous inflammation of the testes (Sir A. Cooper), terminating in abscess (Lloyd, p. 92)—*a*, in the child,

very rare; *b*, in the adult (Baillie's Morbid Anatomy, Abernethy's Museum). John Hunter had seen it in lads of 16, never sooner and very rarely in old people (Works by Palmer, vol. i, p. 597)—of the kidney, terminating in abscess—of the prostate gland, terminating in abscess (Baillie, Lloyd, 107).

Tubercle in the testes; its chief seat the epidydimis; spreading to the prostate, vesiculæ seminales, and throughout the urinary tract.

Tuberculosis of the Female Urinary and Sexual Organs.

Tuberculous (scrofulous) hypertrophy and induration of the mammæ (J. Hunter, Lloyd).

Tuberculous (scrofulous) inflammation of the mammæ, mostly chronic—*a*, circumscribed chronic abscess or succession of abscesses; *b*, involving the whole breast.

Tuberculosis of the Perichondrium and Cartilages.

Tuberculous chronic (inflammation?) erosion; ulceration; ossification (p. 319).

Tuberculous acute inflammation of the fibro-cartilages; ulceration (p. 319).

Tubercle in the cartilages (p. 319).

Tuberculosis of the Periosteum.

Tuberculous inflammation of the periosteum (p. 318), common in the fingers of children (Mr. Stanley, Dr. T. Smith); probably in part the origin of the *exostoses* described by some authors (p. 325), but questionable how far these swellings depend on rachitis (p. 31), the poison of Mercury, &c. (p. 454).

Tuberculosis of the Bones.

Tuberculous arrest of osseous development (*spina bifida*?) *open fontanelle?*) &c.

Tuberculous hypertrophy of bone, occurring generally at the articular extremities (*fusiform fingers, &c.*)

Tuberculous osteitis—*a*, the density of the bone diminished (p. 320); *b*, the density increased (eburnation, p. 321). Abscess; caries; true and false necrosis; tuber-

culous exostosis with caries; said to be very common in Upper India.

Tubercle in bone. This and the last head comprise—caries of the vertebræ (*Pott's disease*); many cases of angular and of lateral curvature of the spine; lumbar abscess; disease of the ilio-femoral joint, of the knee, ankle and elbow joints, and less frequently of the smaller joints; also caries and necrosis of the cranial bones, involving the organs of sight and hearing, &c. &c.

Tuberculosis of the Articulations.

Tuberculous hypertrophy of the synovial membrane—of the ligaments, &c.

Tuberculous chronic synovitis; frequently the primary event in "scrofulous" affections of joints; fungoid or lardaceous transformation.

Tuberculous acute synovitis; effusion; erosion; fungosities, &c.

Tubercles in the synovial membrane (p. 335, from Rokitansky).

Tuberculosis of the Eye.

Tuberculous (scrofulous) conjunctivitis—*a*, oculi; *b*, palpebrarum; corneitis, with ulceration; frequently the earliest local developments of tuberculosis. Decemetitis; iritis; ectropion; pannus; staphyloma; specks, &c.; the sequelæ of tuberculous ophthalmia.

Tubercle in the iris (Dr. Jacob); in the meibomian glands (Lebert, lib. cit., p. 480).

Tuberculosis of the Ear.

Tuberculous (scrofulous) chronic inflammation of the external ear—suppurative (*otorrhœa*).

Tuberculous inflammation of the internal ear—suppurative. Generally with disease of the bone.

Tubercle in the substance of the membrana tympani (p. 346).

Tubercle in the osseous parieties of the ear—in the middle ear (p. 346).

The original intention was to latinize the above schedule, and to adopt appropriate names for each form of disease, but it is necessarily imperfect, and this was found to be impracticable without the introduction of new words, which is always objectionable when done prematurely; it stands therefore simply as a sketch, the lacunæ of which can be filled up, and the arrangement of the whole corrected, as the pathology of the whole and of each disease becomes more completely developed by the investigations now progressing with the aid of organic chemistry and the microscope.

These forms of disease are combined and complicated in innumerable ways, as repeatedly pointed out when treating of the pathological anatomy; a particular case may pursue its course, even to a fatal termination, by its own symptoms and effects alone, as often happens in phthisis; or numerous organs may be simultaneously or successively affected. One external affection may occur singly, continue for years, and then subside; or numerous external affections may occur together. Although tubercle is essentially the same wherever it is deposited, and at all ages, its phases of development differ according to its seat; thus, it may remain crude in the external glands, and even in the mesenteric glands, for years; it is very quickly softened in the lungs, more quickly still in the intestines; and in the brain, it most frequently produces its effect before any of the characteristic changes occur. The effects resulting from the presence of tubercle in the surrounding tissues differ as widely. These and numerous other circumstances give a special history to each form or variety of tuberculous affection.

A few of the more general rules that have been detected relating to the deposit of tubercle, may with advantage be here briefly recapitulated. After the age of fifteen years, the lungs, in nearly all cases, contain tubercles if they exist in any other internal organ, and most frequently if they exist in any other part of the body. Tubercular meningitis, tubercles on the brain, tuberculosis of the peritoneum and of the glandular system, are more frequent in childhood than later in life. The abdominal variety is very slow in its progress, and rarely proves fatal until after the deposit of tubercles in the lungs; in this variety also we sometimes witness tuberculosis in its most highly marked form, proceeding to a great extent without any other organic complication. Owing to the very different consequences which must result from an heterologous

deposit in the peritoneum, as compared with the lungs or brain, tubercle in this membrane may remain for a long time inert and unattended by acute symptoms. Tuberculosis of the osseous system is a rarer disease than sometimes stated; when it occurs, both grey granulation and yellow tubercle are found, and may either be encysted or infiltrated into the cells; and the phases of development of the tubercle are much the same as in the lungs, the softened state being analogous to the vomicæ; and the disease sometimes occurs in the bones without any pulmonary affection. The kidneys may be replete with tubercle, very little being deposited at the same time in the lungs. The symptoms of the general disease are sometimes greatly modified by the local expression of it; thus, the quick pulse, which is one of the most constant of these symptoms, may be rendered natural, or preternaturally slow, or irregular, by the deposit of tubercle in the brain. When the disease is in the abdomen, the frequency of pulse is more constant than ordinary, and even augmented; it has been observed for years from 100 to 120 in a minute, the emaciation proceeding very insidiously and the disease being more chronic than usual.*

As pointed out in former chapters (pp. 49, 109), the occurrence of tubercles in the nervous parenchyma is only an apparent contradiction to the general doctrine adopted in this treatise. They are met with in this site almost exclusively in young subjects, and this has been explained on the principle of the peculiarity of the nutrition of this tissue after the early periods of its development. We do not rely solely on the fact that nervous fibre is everywhere surrounded by cellular tissue, to account for the occurrence of tubercle, and to enable us to refer it to the same disease of the blood; but there are numerous facts, tending to the conclusion, that the deposit of tubercle in the parenchyma of nerves originates during fœtal life, and it becomes a question whether tubercular diseases of the nervous centres are not always congenital.

The variations in the symptoms and progress of tuberculous diseases depending upon age, are frequently well marked; external scrofula in young children, as compared with adults, runs a modified course, it is much less liable to terminate in the deposit of tubercle in vital organs. The acute phthisis of infants, the phthisis of puberty, and the phthisis of old age, have all their distinctive cha-

* Dr. Marshall Hall on Diagnosis, p. 136.

racters. The liability of different organs to tubercular deposit differs at different ages; in the tuberculosis of childhood, for instance, tubercles are simultaneously developed in a greater number of organs than in after life; yellow tubercle is much more frequently deposited without the accompaniment of grey granulations; they are developed with greater rapidity; death more frequently takes place before the softening process sets in, and there is a greater rarity of cavities. Scrofula is met with most frequently in the young; phthisis is perhaps, in this country at least, more frequently developed after puberty, the period when the tendency to scrofula is slight. We can easily understand, that when the blood is tuberculous during growth and development, in the very young, and the causes tending to aggravate its morbid condition are present, that a more general aberration of nutrition will occur, and that the lymphatic system will be extremely prone to the development of disease; and that when tuberculosis sets in later in life, fewer tissues are susceptible of change, the change of matter in the organic tissues is slower, and anatomical and physiological reasons exist for the lungs especially becoming involved.

Thus the deposit of tubercle, tuberculous ulceration and the symptoms, progress and termination of tuberculosis, occur under the most varied circumstances; the secretion and aggregation of tubercle may occupy a longer or shorter period; it may steadily progress or remain stationary at some point of development; it is influenced by the organ or tissue in which it occurs; and by age, constitution, the complications of disease, hygiene and treatment. The remarks under this head are mere illustrations of the specialities of the different forms of disease. These diseases, as already stated, are more or less fully treated of in the works on consumption and scrofula extant, and the only observation further suggested in this place, as respects the whole of them, is that the tuberculous state of the blood must be regarded as *constant*.

SECTION III.

THE GENERAL EFFECTS RESULTING FROM THE DEPOSIT OF TUBERCLE AND SUPERVENING ON AND COMPLICATING THE ORIGINAL DISEASE.

In the *prolegomena*, a distinction is drawn, between the general symptoms resulting from local disease in tuberculosis and the symp-

toms of the original disease of the blood (p. 2). These general effects can only be fully treated of in separate histories of the local affections, from which they take their origin. But notwithstanding the numerous forms or varieties, and the special considerations which appertain to each, there are certain effects of the various local manifestations which are so constantly present, and are so intimately related to the original disease of the blood, that this treatise would not be complete if they were omitted to be described. Moreover, they have hitherto been associated with the general symptoms of tuberculosis; and a reference to them in this place is essential to a correct reading of the history of tuberculosis, as described in this work, compared with the history of tuberculous diseases, as described by preceding authors. I refer to—1, a special modification of the blood, which occurs when local disease has set itself up; and 2, a group of symptoms, denominated "hectic fever."

A.—THE BLOOD IN TUBERCULOSIS AFTER THE FULL DEVELOPMENT OF LOCAL DISEASE.

The blood has attracted more attention from pathologists and organic chemists in the pulmonary form of tuberculosis, than in any other tuberculous disease. We have described the deviations from the healthy standard which it presents in the tuberculous predisposition, (p. 4); and, also, those which occur, as we have reason to believe, in uncomplicated tuberculosis (p. 62); we have now to describe its state after organic disease has supervened; but for this purpose we have to rely almost entirely upon the records extant of its analysis in phthisis. Sixty-one of these analyses are before us, by authorities of the highest reputation, and in this general treatise I propose to record the results of the whole, as a body of important facts that assist us in the true interpretation of the morbid conditions, and enable us to appreciate the general symptoms which result from the local manifestations and complicate the original disease.

Some of the following analyses are referred to in the first chapter (p. 10); with the inference to be deduced from them, as respects the state of the blood in simple tuberculosis; they are inserted here as being essentially the analyses of tuberculous blood modified by local organic disease.

TABLE XXXIII.

Of the relative proportions of the different principles of the Blood in Twenty-one Cases of Pulmonary Tubercles. By MM. ANDRAL and GAVARRET.*

	Bleeding.	Fibrin.	Red Corpuscles	Solid Materials of the Serum.		Water.
				Organic.	Inorganic.	
1st case (*a*)	1	2·1	87·0	58·3	6·8	845·8
2nd case	1	2·9	122·1	75·8	6·6	792·6
	2	2·7	120·4	70 2	7·4	799·3
3rd case	1	3·1	92·5	78·1		826·3
4th case	1	3·8	102·1	91·6		802·5
5th case	1	3·8	85·1	82 9		828·2
6th case	1	3·8	91·4	90·3		814·5
7th case	1	4·7	112·9	100·3		782·1
8th case	1	4·1	105·9	71·5	7·3	811·2
9th case	1	4·4	93·3	72·0	7·3	823·0
10th case	1	4·4	83·5	72·7	8·0	831·4
11th case	1	4·5	97·7	86·2	7·4	804·2
12th case (*b*)	1	4·8	117·7	77·1	7·2	793·2
13th case (*c*)	1	5·1	111·9	98·4		784·6
14th case	1	5·0	108·2	64·3	4·5	818·0
15th case	1	5·5	84·4	89·9		820 2
16th case	1	5·7	89 3	74·0	7·5	823·5
17th case	1	5·6	115·6	90·3		788·5
18th case	1	5·2	108 2	87·3		799·3
19th case	1	5·9	89·7	82·9	6 3	815·2
20th case	1	4·8	76·7	83·3		835·2
21st case	1	4·6	115·0	105·4		775·0
Mean		4·4	100 5	85·4		809·7
Health		3 0	127·	80·		790·

(*a*) A state of marasmus explains the small proportion of fibrin in this case.
(*b*) Complicated with acute *entero-colite* with intense fever.
(*c*) Complicated with acute bronchitis.

TABLE XXXIV.

Analysis of the Blood in four cases of Pulmonary Tubercles after softening and the formation of cavities. By DR. C. FRICK. †

No. of Case.	Solids in 1000 grains.	Water in 1000 grains.	Fibrin.	Corpuscles.	Solids of the Serum.	Ditto, proportionate to the whole Solids.	Iron.	Lime.	Chloride of Soda and Potassa.	Phosphate of Soda and Potassa.	Date of Sickness.
1	169·000	831·000	5·250	94·833	68·917	85·83**	·384	·082	3·992	1·616	March 3
2	198·053	801·947	4·502	117·405	76·046	80·63	·470	·182	5·500	1·462	Feb. 1
3	155·000	845·000	2·352	91·456	61·192	82·94	·376	·027	3·560	1·278	Nov. 6
4	167·436	832·564	4·353	93·061	70·022	88·00	·391	·040	3·924	·705	Nov. 23
Average	172·372	827·627	4·114	99·188	69·044	84·35**	·405	·082	3·973	1 265	
Health .	208·622	791·378	2·952	127·426	78·244		·582	·183	4·822	·874	

This column (**) shews the *increased proportion* of the albumen to the whole amount of the solids of the blood.

* Ann. de Chim. et Phys. vol. lxxv, p. 270. † The American Quart. Journ. Jan. 1848.

TABLE XXXV.

Mean composition of the Blood, obtained from three bleedings each of five phthisical men the individuals being emaciated and enfeebled, and in the true sense of the word anæmic; *that is to say, the total mass of the blood in the circulating system being more or less diminished. The tubercles being in general softened and fever present in all the cases. The first bleedings having been resorted to for pleurisy or hæmoptysis or to moderate the fever, the second in the same individual for similar occurrences, and the third in consequence of a recurrence of hæmoptysis. By* MM. Becquerel and Rodier.

Phthisis.	First Bleeding.	Second Bleeding.	Third Bleeding.	Mean Physiological Standard.
Density of Defibrinated Blood	1056·7	1055·5	1050·3	1060·2
,, the Serum	1028·	1026·3	1025·5	1028·
Water	794·8	799·8	821·	779·
Red Corpuscles	125·	122·7	103 5	141·1
Albumen.....	66·2	65·	62·	69·4
Fibrin	4·8	4·2	3·6	2·2
Extractives and Free Salts	7·7	6·7	8·9	6·8
Fatty Matters	1·554	1·443	1·060	1·600
Seroline	variable	variable	variable	·020
Phosphuretted Fatty Matter	·591	·506	·386	·48
Cholesterine	·134	·171	·100	·88
Soap.....	·809	·766	·564	1·104
In 1000 parts of the Blood calcined.				
Chloride of Sodium	3·3	3·	3·5	3·1
Soluble Salts	2·7	2·6	3 3	2·5
Phosphates.....	·493	·475	·362	·334
Iron.....	·489	·488	·442	·565

TABLE XXXVI.

Mean Composition of the Blood in Four Females affected with Pulmonary Tubercles, each bled once. In two cases the tubercles softened and the patient bled for fever; in one case the tubercles crude, the patient bled for bronchitis and pleuritic effusion; in the fourth case the tubercles crude, the patient bled for slight hæmoptysis and violent pain in the chest. In all the cases the patients greatly debilitated by the disease. By MM. Becquerel and Rodier.

		Physiological.		
	Phthisis.	Mean.	Maximum.	Minimum.
Density of Defibrinated Blood	1055·4	1057·5	1060·	1054·
,, Serum	1028·2	1027 4	1030·	1026·
Water	796·8	791·8	813·	778·
Red Corpuscles	119·4	127·2	137·5	113·
Albumen.....	70·5	70·5	75·5	65·
Fibrin	4·	2 2	2·5	1·8
Extractive and Free Salts	7·6	7·4	8·5	6·2
Fatty Matters	1·729	1·620	2·860	1·
Seroline	variable	·020	·060	imp.
Phosphuretted Fatty Matter	·601	·464	·800	·250
Cholesterine	·082	·090	·200	·025
Soap.....	1·011	1·046	1·800	·725
In 1000 parts of the Blood calcined.				
Chloride of Sodium	3·1	3·9	4·0	3·5
Soluble Salts	2·5	2·9	3·	2·5
Phosphates.....	·302	·334	·650	·250
Iron.....	·484	·541	·575	·486

TABLE XXXVII.

The relative proportions of the different principles of the Blood in Twenty-four cases of Tubercular Phthisis. By Dr. Karl Popp.*

Sex.	Age.	Water in 1000 parts.	Fibrin.	Red Corpuscles.	Residue of Serum.
1. Male	22	806·628	4·069	123·816	65·517
2. Male	22	801·933	5·400	107·038	85·629
3. Male	22	818·505	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
	26 { 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
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	80·704
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
	50 { 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
	57 { 2	854·290	4·009	78·002	63·699
Mean		811·524	4·765	103·215	81·011

Elsner has recorded the following analysis in a case of incipient phthisis in a man, aged 56 years.†

	Incipient Phthisis.		Physiological Standard.
Water	803·404	—	791·900
Fibrin	3·443	—	2·001
Fat from the Fibrin	·153	—	·089
Fat from the other constituents..	·643	—	1·889
Albumen	102·1	—	75·590
Globulin.....	74·948	—	105·165
Hæmatin	2·466	—	7·181
Extracted Matter, Salts and Sugar	11·258	—	14·174
	998·415		997·989

* Dr. Day's translation in Dr. Ranking's Abstract, vol. iii, p. 306.

† Dr. Ranking's Half-yearly Abstract of the Medical Sciences, vol. iii, p. 310.

Analysis of two cases of phthisis in men. (1) In the second stage; (2) in the third stage, with nocturnal sweats and fever—both fatal. By J. F. Simon.

	1	2	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

These analyses may be regarded as complementary to those recorded in the first chapter. It is extremely important to bear several points in mind before drawing conclusions from them. Owing to the different methods adopted by different experimenters, they can only be compared together in connection with the physiological standard adopted by each; which I have accordingly, in some instances, appended. The very decided variations of the healthy blood, in relation to sex and temperament, and the differences attributable to different climates and seasons, must also not be lost sight of. But the existence of local disease, other than the mere deposit of tubercle, and its seat and extent, are the circumstances which exert the greatest influence.

The results of all the analyses agree in the following respects:—

1. An increased proportion of water to the solid constituents.
2. An increased proportion of fibrin, as compared with the standard of health.
3. A diminished proportion of red corpuscles.

Andral and Gavarret's, Frick's, Karl Popp's, Elsner's, and Simon's analyses shew:—

4. That the proportion of the albumen in relation to the whole of the solids is increased; and in most instances, that it is absolutely increased in relation to the standard of health.

According to Becquerel and Rodier, and Frick, who estimate it, and by inference from all the other analyses:—

5. The proportion of iron is diminished.

F. Simon, in whose analyses I am disposed to place great reliance, found the fat increased; in Elsner's and F. Simon's cases, there is a diminution in the extractives and salts, and in Becquerel and Rodier's and Frick's, a diminution of chloride of sodium.

Frick, who found the lime increased in the early stage, found it greatly diminished in the confirmed stage, and the phosphates of soda and potassa, which were diminished in the early stage, were increased in the latter stage; but these and the remaining results are too isolated to allow of any general deductions.

Comparing this statement with those made in the first and second chapters, it appears, that in the complicated stages of the disease, the blood preserves all the qualities of tuberculous blood, with only one well established constant modification; viz., an increase in the proportion of fibrin; the increase being, not only relative, but an absolute increase above the physiological standard.

This increase has already been remarked upon (p. 11); it is only necessary to add, that it invariably coincides with the occurrence of local inflammation. As tuberculous subjects are extremely prone to inflammatory attacks, so are these attacks attended with an augmented proportion of fibrin in the blood; but the fibrin never increases to the extent it does with the same degree and extent of inflammation in the same organs, when the blood is healthy; for instance, by Andral and Gavarret's method, which is that followed in the greater number of the above cases, the fibrin in pneumonia, reaches a mean of between 7 and 8 per 1000, and has been known to attain 10·5. As the inflammatory attacks in tuberculous subjects are chronic, and indicative of a low degree of vitality in the tissues, so is the amount of fibrin in the blood relatively small, and indicative of a low degree of vitality in the blood (p. 15).

In further exemplification, we have only to refer to the remarks made by Andral and Gavarret. They state, that in those cases in which the tubercles were crude, the mean proportion of fibrin is represented by the cypher 4·; when softening commenced it rose to 4·5; and when the lungs were filled with vomicæ it rose to 5·, sometimes reaching 5·5, or even 5·9, but it never attained the height observed in pneumonia. Although the cypher 4· should be taken as representing the mean of the fibrin before the softening of tubercles, the normal cypher being 3· or something under, it has to be remembered, that the irritation set up by tubercles may occur for a considerable time before any evidence is afforded of softening or inflammation. In a subsequent communication,* M. Andral states, that so long as tubercle con-

* Essai D' Hématologie Pathologique, Paris, 1843, p. 164.

tinues hard, without any sign of inflammation around it, the proportion of fibrin continues normal; and in proportion as the process of softening proceeds, and the effort at elimination is set up, this being of an inflammatory character, the blood becomes gradually more and more changed; so that the excess of this constituent unquestionably depends upon the inflammation which supervenes in tubercle at a certain stage of its existence.

There is a point, however, beyond which this progressive increase in the proportion of fibrin does not continue to take place. Whenever the disease has advanced to the final stage, and the patient is reduced to a certain degree of marasmus, it begins to decrease, and continues to do so together with the corpuscles. In bleedings practised on 14 patients, where the lungs were full of vomicæ, the fibrin was found to be only as low as 4·, in three it oscillated from 4·4 to 4·6, and in the others it reached 5· to 5·9. It may even descend below the physiological standard; in one of the cases, in Andral's table, where extreme marasmus existed, it was as low as 2·1; it attains its maximum about the period when the febrile symptoms are regularly established.

The gradual diminution of the red corpuscles which commences before local disease sets in, and is in fact one of the most essential characteristics of the blood disease, according to the whole of these analyses, continues, not only throughout the period of softening, but in the very last stage. If, throughout the stage of softening the proportion is generally above 100 (the physiological mean being 127), in the second stage it is almost constantly below that standard, and in the last stage it falls still lower; but even then M. Andral never found it below 83.

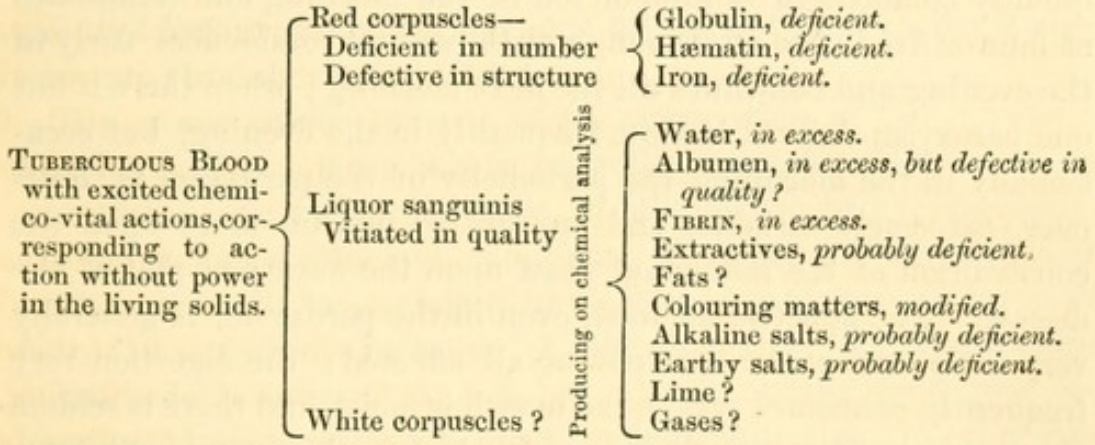
As the disease advances and the tubercles first soften, and then caverns are formed, the clot becomes progressively smaller and smaller, and is covered with a buffy coat, so much the thicker and better formed as the pulmonary disorganization is more advanced. Two circumstances contribute to the formation of the buffy coat, the increased proportion of fibrin and the diminished proportion of red corpuscles, there is excess of fibrin in relation to the red corpuscles. The presence of a buffy coat is accordingly almost as constant a phenomenon in the advanced stages of phthisis as in acute pneumonia or articular rheumatism.

Karl Popp found the temperature of the blood below the "average standard," by which we presume that it was lower than

the ordinary temperature of inflammatory blood. He also noticed that in three cases it was of an unusually bright colour; so far confirming an observation of some of the older authors. This scarlet colour, with a diminished proportion of red corpuscles, is consistent with the view of their perfect, if not excessive, oxygenation.

In one case, the serum was milky from the presence of fat globules; and generally, the colourless corpuscles were especially abundant, as they were also found to be in pneumonia.

The following diagram represents the state of the circulating blood; and its resolution into its chemical elements, in advanced tuberculosis with local disease; and may be compared with the diagram inserted at page 15.



These diagrams shew how much remains to be investigated, in relation to the blood, in tuberculosis, as in all other diseases. The increase of fibrin is here referred to the supervention of inflammatory action upon a tuberculous state of the blood. An increase of this principle has uniformly been observed in hectic fever, and the question arises whether hectic is always associated with inflammation. It is not very likely that, even for analysis, the blood has been drawn where hectic existed, without inflammatory symptoms having also been present; so that the point is not so easily determinable by direct observation. Inflammation, even in a tuberculous state of the blood, is certainly attended with increase of fibrin, and it is probable that the excited vital actions, which will presently be described as characterizing hectic, are also attended with an increase of the proportion of fibrin, in cases where local inflammation does as in those where it does not exist.

B.—THE HECTIC OF TUBERCULOSIS.

It has always been a question, in our view, with what degree of propriety hectic symptoms are denominated "fever." Although the two have many circumstances in common, as have many blood diseases, the symptoms of hectic differ from those of fever, most essentially, in their origin, character, and progress. Hectic is unattended with that kind and degree of debility which belongs to fever; when the symptoms are at their height, instead of being *prostrate* the patient is stronger than in their absence. In a well formed hectic there is never a total absence of symptoms; and these may endure for months, if not for years, the patient recovering on the subsidence of their cause. They have remissions and exacerbations, sometimes once, sometimes twice daily; in the latter case one paroxysm frequently commences at nine or ten in the morning and terminates at four or five in the afternoon, and the second commences early in the evening and continues till the next morning; when there is but one paroxysm daily it is most frequently in the evening, but occasionally in the morning; the periodicity of the paroxysm is, however, extremely variable, and appears to depend more upon the constitution of the individual than upon the nature or seat of the disease. The appetite for food, even in the paroxysm, is generally very little and sometimes not at all affected; the digestion very frequently continues good; the mouth is moist, and there is seldom much thirst. There is seldom any headache; the senses and judgment are commonly good; the mind is confident and hopeful; and there is a total absence of delirium. These circumstances are all remarkably characteristic of hectic, they are of course liable to modifications; as, by the occurrence of disease of the stomach impairing digestion, or of effusion in the head occasioning delirium for a short period before death; but they may continue, as here described, for weeks and months, during the progress of tuberculosis of the lungs and other parts; and comparing them with the symptoms of fever, to the circumstances of which they are in many important respects the very antitheses, it appears marvellous that they should have been so constantly regarded in the same point of view. Without entering into a minute description of all the symptoms which occur, my own observation recognizes three stages in the hectic paroxysm; which, although, in innumerable cases, by no means well defined

nor constantly present, occur distinctly in a sufficient number to admit of analysis.

The *earliest period* of the hectic paroxysm is marked by a sense of heat and burning, and a suffusion of the capillaries, in the face, hands and feet. This is preceded or attended with a slight degree of cold shivering, or an undue sensibility to the sensation of cold, and by aching pains in the limbs, which are often compared with or mistaken for rheumatic pains. These symptoms, as we shall presently see, have an etiological signification; they are extremely irregular as to their sequence; sometimes the pains in the limbs precede the flushing; or the sense of cold precedes both; sometimes the flushings of the face occur without the burning sensation in the hands, and conversely; but it very rarely happens that a hectic paroxysm occurs with the total absence of these symptoms; and occasionally, for some time, one or more of these earlier symptoms are the only ones observed.

The *second period* consists of an aggravation of the increased frequency of the pulse which generally prevails. We are here regarding hectic as it supervenes on fully established tuberculosis, one of the most constant symptoms of which is a frequent and weak pulse. In an "exquisitely" formed paroxysm, it numbers from 110 to 140 in a minute. At the same time, the temperature of the body is uniformly raised, but it never attains the degree belonging to inflammatory fever or entonic inflammation, in otherwise healthy subjects; rarely exceeding, according to my own observation, 103°; being with difficulty maintained; and as soon as the critical stage sets in, rapidly falling. It may be here remarked that increased frequency of pulse and rise of temperature are direct effects of any irritant received into the blood.

The *third period* is characterized by profuse perspiration, or colliquative stools, or both; which sometimes alternate with each other; the perspiration continuing for several weeks, and then being replaced by the diarrhœa. During this period, the urine, although sometimes pale and without deposit, is generally of a high specific gravity, acid, of a deep colour, and smaller in quantity than natural; it usually deposits a copious brick-red or branny sediment; consisting mainly of urates, which are frequently tinted by the addition of purpurine, of various shades from a pink to a deep purple; thus indicating an excess of uric acid and the presence

of a foreign hydro-carbonaceous material. The increased ratio of the uric acid to the urea has already been commented upon (p. 575). How far it may depend upon the emaciation resulting from the progress of the primary disease, and how far upon the superinduced hectic paroxysm is not easily determined, but it is clearly referrible to both.

That the supply of food has nothing whatever to do with the excess of uric acid and the appearance of the urates in the urine in the hectic paroxysm, is proved by hectic, with the characteristic urine, occurring in cases attended with a total failure of appetite, just as certainly as in those in which the appetite is retained to the last. This condition of the urine indicates that a greater quantity of the organic tissues, either in the body generally, or in some particular structure, is losing its vitality, breaking up as it were, and by its analogue, being re-absorbed into the blood, than the oxygen in the blood either consumes or converts into urea.

That the perspiration of the hectic of tuberculosis has peculiar qualities may be inferred from its odour, which is not easily described although well marked; it has appeared to me something between musty and earthy, with a slight degree of acidity. Stark is quoted by F. Simon as having found albumen in this fluid, which the latter failed to detect; but he states that fat sometimes occurs. Its physical and chemical qualities have yet to be investigated.

During the recurrence of the hectic paroxysm, as here described, there is every reason to believe, that the blood contains an excess of fibrin, independent of the existence of local inflammation. A patient has been known to be bled more than fifty times in the progress of pulmonary tuberculosis, and the blood last drawn was as sizy as the first (Simmons). The writers of the period when it was customary to bleed frequently in phthisis, uniformly describe the blood as buffy.

Analysing the symptoms, as above described, and affording them a careful consideration, in relation to the existing state of our knowledge of the physiology and pathology of the fluids, there can, I think, be no doubt, that they depend upon the periodical reception of a "poison," an "acrimony," or an "irritant," into the blood. The symptoms of the first stage are clearly those of the

reception of some foreign material into the blood; the symptoms of the second are clearly those of the irritating effects of such material; the symptoms of the third stage are clearly those of elimination, either with or without its previous dissolution. But whence this material and what is its nature? It can be no materies morbi derived from without; all the facts are opposed to the supposition. It is true that the absorption into the blood of the products of digestion, frequently produce, even in healthy constitutions, shiverings and flushings, and that Galen and many of his followers considered that the paroxysm of hectic is always brought on by taking food, but the closest investigation has shewn that the paroxysm is independent of any direct exertion of this influence; in some instances it comes on as constantly when little or no food is taken, as when the appetite and digestion remain good.

No satisfactory account has ever yet been given of the cause of the hectic paroxysm. The theory that it depends upon the absorption of pus has met with the most advocates, but as it appears to us, the arguments advanced by John Hunter set this at rest. There are numerous cases in which pus is absorbed without producing hectic; the absorption from syphilitic buboes, for instance, does not produce hectic, but another disease; hectic frequently occurs before the formation of pus or without its being formed at all, and it as frequently subsides while absorption is going on (Works by Palmer, vol. i, p. 433). The experimental researches of Velpeau, Cruveillier, Gaspard, Majendie, and, more recently, those of Sedillot,* confirm this opinion. When pus entire, or the pus globule, is received into the blood, from an inflamed vein, or by absorption or artificial injection, the symptoms produced are not those of hectic, although they have some analogy to them. Shiverings, alternations of temperature, accelerated respiration, frequent pulse, sudamina, prostration and rapid emaciation, which characterize the hectic of tuberculosis are present, but when the blood is embued with any notable quantity of pus, to these symptoms are added stupor and delirium, irregularity of pulse, dryness of the tongue and lips as in typhus fever, pains in the epigastrium, subsultus tendinum, retention of urine, paralysis, ulcerations of the cornea, and suppuration of the conjunctiva, a leaden or jaundiced hue, purulent effusions into the joints, muscular and visceral abscesses, and other symptoms, none

* De L' Infection Purulente ou Pyoèmie, Paris, 1849.

of which occur in the innumerable cases of tuberculosis attended with hectic. Pyohæmia also leads much more rapidly to fatal consequences.

Notwithstanding this, it may still be a question whether hectic by the milder character of its symptoms, and the periodicity and progression of its stages, is contradistinguished from purulent infection, as being produced by a gradual absorption and periodical elimination of pus *modified* by secondary assimilation. There are many circumstances which favor this view.

The following are the considerations which suggest themselves on a review of the whole subject:—

The hectic paroxysm if produced by an irritant received into the blood, most probably takes its rise from the destructive processes in the organic tissues. It may be an animal acrimony produced from the effete materials and absorbed into the blood. Either the destructive processes in the tissues generally, after the malnutrition has attained a certain stage, or those in particular organs or tissues in which local disease has occurred, might furnish such an irritant. This view, without making hectic identical with pyohæmia, is consistent with its production from the materials of scrofulous or tuberculous pus, or tubercle itself, or of tissues, the nutrition of which has for sometime been tuberculous; it is consistent with all the symptoms of the paroxysm; and it is perfectly consistent with the history of the affection, as respects its duration, and its complete subsidence when the cause which produced it has been removed.

The periodicity of the returns of the hectic paroxysms is the chief, if not the only anomaly, we have to contend with; and here pathology fails us, just as physiology is defective. There is no mention of periodicity in reference to the interstitial absorption of the higher order of animals. In Dr. Carpenter's last work on "General Physiology," it is stated, that in vegetables, the quantity of fluid absorbed and the force with which it is propelled upwards in the stem, vary in the same plant in different periods of the year, and "even of the day" (p. 654). We observe laws of periodicity in operation as respects nearly all the functions of organic and animal life, throughout the whole range of the animal creation. In the human constitution, sleep, hunger, and excretion are strictly periodical. The pulse is subject to periodical—diurnal—modifications of force and frequency. *The urine is subject to periodical*

changes as respects the very materials which it is believed to derive, mainly, from the effete tissues; its uric acid, urea and colouring principles. In the face of these considerations it is extremely difficult to believe that interstitial destruction of tissue and the absorption of the cast-off materials is, even as a general law, a *constant* and *equable* process. The fact that exercise augments the quantity of urea in the urine, while at the same time it increases the perspiration (Lehmann), is a proof that the process of absorption is subject to disturbing causes; and, as respects the endosmodic and exosmodic currents, by which absorption is effected, when we reflect how easily they are influenced, and even *reversed*, we can scarcely escape from the inference that interstitial absorption has its periodical accessions and remissions.

If interstitial absorption is essentially periodical, or subject to periodical accessions and remissions, the periods must be in relation to the periods of hunger and repletion, of exercise and rest, of excretion, and of the action of the heart and arteries; and accordingly they must be also in relation, not only to the habits of the individual for the time being, but to his habits and customs even from birth. These considerations would account, on the one hand, for Galen and many of his followers believing that the hectic paroxysm is always brought on by the taking of food; and on the other hand, for others, not observing a direct relation, denying altogether such an influence. There can be no doubt that the periodicity, and even the intensity, of the hectic symptoms are influenced by the taking of food; and there is as little doubt that they recur independently of the alimentary ingesta, as there is, that interstitial absorption continues after the appetite has totally failed and nutrition is reduced to the lowest point.

There is yet another, the dynamic view of the periodicity of the hectic paroxysm, which must not be overlooked. Admitting the absorption of an irritant into the blood, or any other cause of excited action, and bearing in mind the diminished vital force of the heart, of the blood, and generally of the organic cells and tissues, we can conceive that the available vital power is not sufficient to sustain the increased momentum of force resulting from the action of the irritant; the result must be collapse, not only in the vascular and muscular motor systems, but in the organic nutritive powers; whence a failure of vital resistance to the disintegrating processes, as well as a failure of resistance in the emunctuaries. This ex-

plains the diarrhœa, the perspirations, the increased disintegrations of tissue and the increased emaciation; the vitality of the materials of cells and fibres being exhausted they become effete, furnishing new materials to be absorbed into the blood and to act as irritants; renewing the paroxysm as soon as, by sleep or digestion or the lapse of time, the vital power shall be sufficiently accumulated.

Thus, we have not only the probable quotidian or double quotidian absorption of an irritant into the blood and its periodical elimination, but a periodic accumulation and exhaustion of vital power, to account for the hectic paroxysm; and when we consider the irritability of the vital organs in the tuberculous constitution, owing to the diminished vitality of the blood (p. 15) and of the organic structures generally, there can be no surprise that the paroxysms should be partial or general in their effects, unequal in their force and duration, and for the most part uncertain and irregular in their returns.

CHAPTER VIII.

ON THE TREATMENT OF TUBERCULOSIS.

Therapeutical indications can only be founded on a knowledge of the nature and causes of disease, and as long as this knowledge is defective they must be incomplete. At the same time, no doubt can exist of the importance of indications, and rational medicine requires that we should establish them upon a strictly scientific basis. It is here, as in other branches of practical medicine, essentially necessary to discriminate between that which is known and that which is conjectural. The assemblage of indications ought, in fact, to constitute the rational plan of treatment, and to mark the distinction between scientific and empirical medicine.

In laying down indications for the treatment of tuberculosis, I confine myself to the disease of the blood, or constitutional affection; the local affections which supervene being regarded as secondary. Many of the latter are of a nature to demand a modification of the treatment, but the first and most important consideration with the practitioner is obviously, to determine the appropriate remedies for the constitutional affection, upon which all local disease primarily depends. Whatever methods of cure we may find available for local disease, they can prove of little benefit if the diseased condition of the blood be allowed to continue; whereas, if we can alter the state of the blood, the local disease, not being too far advanced, may get well spontaneously. This consideration has been too frequently overlooked, and it explains some of those remarkable cures that have occurred, contrary to the worst anticipations of the unlearned, and in defiance of the therapeutics and prognostics of the learned. Even where the cure of a local affection has become a primary object with the practitioner, and interferes detrimentally with the constitutional treatment, the rational indications for the latter ought never to be lost sight of. In practice, we have too frequently a choice of evils; the facts and principles developed in this work, it is confidently hoped, will aid the judgment in such unfavourable, frequently complicated and difficult, and too often

fatal cases; and if correctly applied will assist us, while steering clear of one rock to avoid the other, so as to give the patient the best possible chance of recovery.

Of the curability of the disease as it presents itself in various forms coming under the designation of "scrofula," there can be no question. An opinion, founded chiefly on pathological anatomy, in favour of the curability of tuberculosis pulmonalis, is gaining ground. But it is demonstrated under the eye of the practitioner daily, that so long as the symptoms referrible to the constitutional cause continue, the local disease progresses, and it is a mere physiological truism, that after the lungs or any other vital organ become disorganized to a certain extent, all hope of recovery is vain. In cases where recovery has unexpectedly taken place, the disease of the vital organ has been limited by an arrest of the constitutional disease. How important then is it in practice, that we should bear in mind all that relates to the symptomatology, etiology, diagnosis, prognosis and treatment, of the constitutional disease. Not only the prevention of its localization in particular organs, from the lymphatic glands to the organs most essential to life, as the lungs and heart; but the arrest of tubercular aggregation and its consequences, inflammation, suppuration and ulceration; the healing of external ulcers and internal cavities; the absorption of the animalized parts of tubercle; (p. 139) the formation of sound cicatrices, whether in the skin or the lungs; and also the improvement of the general nutrition and cell growth, so as to enable the tissues to resist noxious influences and to set up those healthy actions and reactions which are essential to reparation after injury; are all dependent upon the correction of the tuberculous state of the blood.

Regarding tuberculosis as an idiopathic disease of the blood, produced by some cause or some combination of causes, directly influencing the process of hæmatosis, and chiefly characterized by a low degree of vitality—a vitiated constitution of the liquor sanguinis—a diminution of the proportion of the red corpuscles—defective cell growth—and consequent atrophy, pallidity and softness of tissue, with debility and morbid irritability—and liable to be transmitted hereditarily from generation to generation;—also, having regard to the history, symptoms and probable causes of the disease;—the primary indications, prophylactic and curative, appear to me to be:—

I. To prevent the hereditary transmission of the disease.
II. To prevent, in the propagation of the species, the production of the disease, or of those states of the constitution which act as predisposing causes.
III. To prevent the development of the disease in the fœtus.
IV. To correct the predisposition and to prevent the development of the disease after birth.
V. To cure the tuberculosis, and thereby to prevent the deposition of tubercles, or to render them innocuous when deposited.

These are the general indications which present themselves in accordance with the principles adopted in this work; all the forms or varieties being regarded as differences in grade or intensity, or as local complications, of one specific general morbid condition of the solids and fluids; arising from a diseased state of the blood. All the important questions which have come before me, practically, during a long series of years, are referrible to one or other of these heads, I therefore propose to embrace the more detailed investigation of the treatment under five corresponding sections.

The principles of treatment are all founded on our knowledge of the symptomatology, pathological anatomy, and causes of the disease, rather than upon any of the theoretical views that have been so fully described. It has been shewn, that we are still ignorant of the essential nature of the morbid element, or of the primary change whence the whole of the effects proceed, and that our theory is necessarily imperfect; it would accordingly be unphilosophical to found rules of treatment upon conjecture or hypothesis. If we were to pursue this course, we should incur the risk of finding our theories contradicted by our experience, which can never be the case so long as we interpret our observations correctly and give to theory no more than its legitimate value.

SECTION I.

OF THE MEANS BY WHICH THE FIRST GENERAL INDICATION OF PREVENTING THE HEREDITARY TRANSMISSION OF THE DISEASE IS TO BE FULFILLED.

In the chapter on causation I have so simplified the idea of hereditary transmission, that the means of prevention under this head reduce themselves, chiefly, to points of selection or exclusion as respects the matrimonial alliances of tuberculous subjects, which

points are founded upon a knowledge of the laws of generation and of the hereditary transmission of diseases.

The deplorable results frequently entailed upon the progeny of tuberculous parents, ought, it may be imagined, to have produced more caution on this point than exists. It is a very remarkable fact, that even medical men appear, frequently, to set at defiance the most obvious hygienic laws; and if the profession, by its example, sets its own doctrines at nought, there can be no surprise that the public generally should follow that example. It is very rarely indeed that the medical attendant, even if appealed to at all, is consulted before matrimonial engagements are so deeply contracted that it is too late to retract; and this is perhaps one excuse for the cursory attention generally given to the subject by practical writers; and for the paucity of fixed principles upon which a medical opinion ought to be founded.

In a general treatise, this part of the subject, however abstruse and difficult, cannot be evaded. I therefore venture to state what appear to me to be the more general and most applicable rules, deducible from admitted physiological principles and from empirical facts, without any regard to the theories of generation that have been adopted by writers on the subject.

The law of hereditary transmission—that a tuberculous state of the blood in either parent is liable to be transmitted to the offspring, and that the children of tuberculous parents, again, in their turn, become the parents of children often much more tuberculous than themselves, has resulted in so much evil to the human race, that it has been frequently proposed to correct it by legislative enactment, interdicting marriages under particular circumstances. Lugol, assuming that one-fifth of the entire human race is now affected with tuberculosis (scrofula), calculates that the disease would disappear after three or four generations, if the marriage of tuberculous persons was interdicted by law. But setting aside the almost utter impracticability of framing and enforcing any such law, so as to prove effective, it is not likely, in the present state of civilization, to be attempted. The only remedies to be trusted to, are the general diffusion of information on the subject, the good sense of the community, and the influence of the medical profession.

It has been already pointed out that no disease becomes absolutely specific. That is to say, which, like the specific character

of man, for instance, becomes universal and permanent. It has also been intimated that modifications of the specific state of organized beings — pathological modifications — may be *innate*. Children may be affected from birth with modifications of structure and function from which their parents are exempt, and yet derive them from the period of conception. None of these modifications become normal and necessary phases of development. There is always a marked opposition between the character of the species and the signs and symptoms of a disease. Disease is always a degradation of the type of the species. The observation of disease shews, incessantly, transpositions of elements, degeneracies, metamorphoses of form, the result of the disturbance of the physiological order or specific character of life (Andral). Pathological characters are always consecutive to a pre-existing physiological or specific state of the being.

Since we cannot alter or suspend the laws which regulate the transmission of diseases, which are the laws of nature, the primary indication under this head should be, to make the laws of hereditary transmission react upon themselves. That is to say, we should endeavour, in the union of the sexes, to modify the result by changing the circumstances under which the laws operate ; and in giving advice on this head we ought as much as possible to be regulated by fixed principles.

These principles relate to *selection* and *exclusion* as to *persons*, in the marriage of tuberculous subjects.

1. Without entering into the physiological question of the effects on the offspring of *consanguinity* in matrimonial alliances, it may be laid down as an absolute rule, that where tuberculosis exists in a family, the intermarriage of the members of that family should be peremptorily prohibited. There can be no doubt whatever, that the vices and deformities, and the morbid predispositions and diseases, both of body and mind, are perpetuated and increased by such connexions ; and that the health, the viability and the fecundity of man, as of vegetables and animals, are deteriorated, and families, races and species, even become extinct. This law applies especially to tuberculosis, and from it we deduce that blood connexions in such families ought never to be allowed to intermarry.

2. After consanguinity, the next important principle of exclusion relates to the *intermarriage of individuals personally affected with tuberculosis*, or personally free from any evidence of the disease,

but whose mediate or immediate progenitors, direct or indirect, are or have been affected with it.

That tuberculous children are more certainly and more inveterately the result where both parents are tuberculous, or both hereditarily predisposed to the disease, is abundantly proved.

Accordingly, the children of tuberculous parents, however robust and healthy, ought to be most especially guarded not to contract matrimonial alliances in tuberculous families; but, on the contrary, to make not only a healthy constitution, as respects the individual, but freedom from hereditary taint in the family, a necessary contingent. By attention to this common sense rule, and by proper management after marriage, the tuberculous condition of the blood might be completely eradicated in a family.

The daughter of a consumptive parent, sustaining her own health by a rational course of life, and married to a healthy man, although herself hereditarily affected with tuberculosis, may give birth to children nearly, if not quite free from the tuberculous taint, in the first generation; and these again, by attention to the same rule, may give birth to children in whom no trace of the disease remains. But, although the children in the first generation shall be free from any manifestation of the disease, if the hygienic laws are deviated from, either by themselves or in the second generation, the disease is liable to return in its pristine vigour. This accounts for a great proportion of the instances of the apparent anomaly, of the disease passing over one generation to reappear in the next.

The case of a perfectly healthy female marrying a man whose parents are tuberculous is not exactly parallel. Here the germ, as derived from the male parent, may be tuberculous *ab initio*. The more perfect the blood of the mother the more probable it is that the hereditary taint, derived from the father, may be counteracted; and the tuberculous nutrition of the tissues superseded by healthy nutrition; but it may happen, that however perfect the blood of the mother, the original taint is so inveterate, that it cannot be corrected by healthy nutrition; the embryo and fœtus are indelibly stamped with the tuberculous type; and the result is either its death in utero, or it is brought into the world with a tuberculous constitution. An analogous case is exhibited in the vegetable kingdom; good seed may thrive well and bring forth good fruit in an indifferent soil, but radically bad seed will not thrive in the best soil.

The laws by which the hereditary transmission of tuberculosis is governed then peremptorily dictate, for the purpose of affording tuberculous subjects the best and sometimes the only chance of a healthful progeny, that they should avoid intermarriage with individuals whose progenitors, mediate or immediate, direct or indirect —father, mother, grandfather, grandmother, uncles or aunts,—have been affected with the disease; and this exemption should hold good whether or no the individual exhibits the signs of the disease in any of its forms or grades.

3. The principle of exclusion in the marriage of the members of tuberculous families, ought to extend to sickly and weakly subjects of all classes, but more particularly to those affected with inveterate dyspepsia or chronic diseases of the digestive apparatus, to the gouty and to the children of gouty parents, to the chlorotic, and, under circumstances, to the children of chlorotic parents, and those affected with calculus and certain skin diseases. The feebleness of the organization of the children of such parents predisposes them to the action of the inducing causes of the disease, and renders the specific morbid change transmitted from the other parent much more destructive in its consequences. There are no facts that I know of to prove, that a woman who has been chlorotic in youth is thereby rendered more likely to have a tuberculous offspring, but all analogy justifies the conclusion, that the long continuance of the chlorotic condition must have its effect; and on this ground alone the propriety of attending sedulously to the permanent improvement of the health of chlorotic females, by hygienic and medical treatment, is rendered obvious; and we should not recommend, as a matter of preference, that a member of a tuberculous family should form a matrimonial alliance with such a subject, although the circumstance is one of daily occurrence.

The preceding remarks relate to the principle of exclusion, those which follow to that of *selection*.

4. Individuals affected with tuberculosis, and members of tuberculous families, where they do not regard it as a moral duty to abstain from marriage, will have their chances of a healthful family increased, when the selection for the conjugal union comprises the principle of *crossing*—in other words, where the union takes place with individuals possessing qualities *contrary* to their own.

But this principle must not be admitted in too arbitrary a sense.

No advantage would result from intermarriage with an individual affected by another disease, or constitutional defects of another character. In this case, the offspring would almost certainly become affected with one disease or other, or with a combination or modification of both. It may be laid down as an invariable rule, that diseases should never be crossed. When tuberculosis and gout are crossed, the stronger children have been observed to inherit the gout, and the weaker children tuberculosis.

Physiology teaches that the hereditary transmission of individual or acquired qualities has its limits, and the transmission of diseases has also its limits. If individuals affected with transmissible diseases of a fatal tendency, like tuberculosis, intermarry, and continue to do so, from generation to generation, the respective *families* soon become extinct. If an individual affected with a transmissible disease intermarries with a healthy individual, and their progeny again with healthy individuals, the *disease* soon becomes extinct. Mr. Alexander Walker * considers that families, by intermarriages founded on rational principles, and in conformity with the natural laws so clearly established, may "surely, easily and quickly," some in their first, others in their second generation, raise themselves, at least in some of their members, from deformity to beautiful organization, from disease to health, and from stupidity to high mental culture. "The means of improvement are in the power of every family."

The number of generations that may be required to effect this is doubtless variable, but still limited, and it is a very curious question to determine the limits, for which purpose we are not wholly without facts. It has been stated that three or four generations only, if methodically crossed, are required to blanch a negro or to blacken a white. The Hindoos, the most jealous people as respects caste, hold that seven generations are sufficient to acquire or lose a caste. It has been determined experimentally, that from four to seven generations are sufficient to reduce one race of animals to another. These facts derived from physiology do not furnish us with any rule, they seem only to convey an approximative idea of a limit. The limit in physiology depends greatly upon the characters transmitted, and in pathology upon the nature of the disease.

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* On Intermarriage, or the Natural Laws by which Beauty, Health and Intellect, result from certain unions, and Deformity, Disease and Insanity, from others, &c., 1841, p. 284.

In physiology, all innate and congenital characters have a great tendency to persist in the offspring, and if it be admitted that tuberculosis is sometimes innate, or produced in the embryo, this persistency will no doubt hold good; so that an individual born with a tuberculous constitution is especially liable to transmit the disease to his offspring. In such cases, totally apart from any other consideration, all the most judicious rules are required to be put into force, to prevent hereditary transmission.

Characters acquired after birth are generally not so persistent in their succession. Their duration depends upon the nature of the modification, its standing, and the persistence of the cause. In proportion as diseases are necessarily and rapidly mortal they are less likely to be transmitted. When of a certain degree of intensity they destroy both the instinct and the faculty of reproduction; in a still more intense degree they scarcely give time for the birth of the infant. Other things being equal, the more recent diseases are, the less likely they are to be transmitted. Their permanency, and the continuance of the action of the causes which have produced them, renders them more likely to be transmitted. Hence acquired tuberculosis, particularly where the individual is removed from the operation of its causes, where it has been, comparatively, of short duration, and in the less inveterate forms, is much less liable to be transmitted. I know fathers and mothers who had scrofula in their youth with perfectly healthy families.

But I doubt very much the dogma laid down by some writers (Fournet, &c.), that the hereditary influence is cæteris paribus, less when tuberculosis is acquired than when it is hereditary; and accordingly, that the disease is necessarily, or by a law of hereditary transmission, more inveterate in the second than in the first generation, and in the third than in the second. That this result may frequently be observed there can be no doubt, and that families may in this way become extinct, even in the third generation, is equally unquestionable. When this happens, I believe there is something more than a simple transmission of the disease from one of the parents to the offspring; as, for instance, the existence of the disease in both parents; or the offspring inheriting the disease from either parent, and the mother being subject to the inducing causes during utero-gestation; or the child predisposed by hereditary transmission, being also subject to anti-hygienic influences. My own observation leads me to the

conclusion, that in the absence of such ancillary causes, acquired is often more inveterate and more certain in its transmission than hereditary tuberculosis.

It may be adopted as a principle, that advantage results from the crossing of temperaments, when a constitutional affection appears to have its origin or essence intimately associated with any particular temperament. A tuberculous subject of a lymphatic temperament will have a better chance of a healthy progeny, from a union with, not only a healthy subject, but one of a sanguine temperament. Tuberculosis is, however, so associated with the lymphatic temperament, that a tuberculous subject of a sanguine temperament cannot form a matrimonial alliance with a healthy subject of a lymphatic temperament without augmenting the risk of having children born tuberculous. The most general rule that can be laid down is, that the hereditary transmission may be superseded, and a healthy progeny result from a tuberculous parent, according to the perfection of the constitution and of the health of the opposite parent; and although, notwithstanding the most advantageous crossing, the disease may be transmitted hereditarily to the immediate progeny, the ultimate tendency of well advised and methodical crossing, in successive generations, is to restore the physiological condition and the original type of the species.

The phenomena of generation very clearly indicate, that the offspring inherits some qualities from one parent, and some from the other, and that the characteristics of the child are greatly dependent upon the relative vigour of the different physiological systems of the parents. Were these laws accurately made out and well established, we might perhaps found upon them rules by which disease might be excluded in the first generation; as it is, the only principle we can admit is, that the influence of the more vigorous parent will most frequently prevail; thus the female may give many of the more important characteristics of her organization to her progeny simply by being relatively more vigorous than the male. Lugol appears to me to take an entirely different view of this point; he attaches the greatest importance to the relative sexual superiority of the male for the production of healthy children. He considers that it ought to be the fundamental law of marriage, and that where it is absent, and the male is relatively more feeble, his reproductive faculties are debased.

"A man may even become positively impotent in consequence of an exaggerated degree of relative inferiority." This author maintains that the common notion of the feebleness of the father's constitution, being compensated for by the vigour of the mother, is an error; he does not consider it possible in any case. On the contrary, it is occasionally observed that a healthy man will become the father of healthy children, although the mother be of feeble organization, and he explains this upon the principle that constitutional vigour is derived from the father rather than the mother.

We have no doubt that, although there is some truth in this principle, Lugol's views are by far too exclusive. We have under our own observation instances of tuberculous husbands married to women of vigorous constitutions who have never borne children at the full period, but have had repeated abortions; but we have at the same time under observation several instances of men of very feeble organization married to healthy women who have borne perfectly healthy and vigorous children. We believe that in extreme cases, the reproductive power in the male is so debased, that on the principle, of bad seed not fructifying in the best soil, there will be abortive or diseased germs, but in the more ordinary case of the tuberculous habit in a slighter degree, that the laws of generation confirm the principle of crossing in this particular, and that the relative vigour of the constitution adds another element to the chances of success. The principle of contrast, or crossing, is also extended advantageously to differences of family, locality of residence, bodily organization, habits, mental and physical occupations, and the like. "The infusion of plebeian blood has given a new and vigorous impetus to an ancient stock, that had well nigh become extinct." (Dr. T. Smith, lib. cit., p. 152.)

Notwithstanding every precaution and the greatest possible care as to selection and exclusion in matrimonial alliances, although an individual predisposed to the disease shall be united with another perfectly exempt, in the best state of health, and of an opposite temperament, the tuberculosis may appear in the offspring, and if we regard the immediate effect only, the result of these precautions appears to be contradictory; but if this system be followed in a succession of generations, the result is otherwise; by an unerring law of nature, in pathology as in physiology, the deteriorated constitution of the individual progressively subsides, and the constitu-

tion recovers its healthy state, the blood and the organized structures under favourable circumstances reverting to their specific or physiological state.

These principles have to be regarded in any opinion that may be given as to the propriety of matrimonial alliances. There are others which might be deduced from physiological laws. Unfortunately any very precise rules under this head would be of little avail. They too frequently prove nugatory, from the total indifference of the parties. In the propagation of animals and plants for the supply of his wants, or the gratification of his appetites, and for his interests and pleasures, man considers the future and the interests of race; in the propagation of his own species he consults his taste and his individual interests, or he is influenced by his passions and desires, and he sacrifices the interests of family, of the future, and of the human race (P. Lucas). Human nature is so constituted, that probably, in the main, it will ever be thus, but it sometimes happens that the higher principles predominate, and it is then that the well considered opinions of the professional adviser will enable him to carry out those philanthropic objects so inseparably connected with the healing art.

SECTION II.

OF THE MEANS BY WHICH THE SECOND GENERAL INDICATION OF PREVENTING, IN THE PROPAGATION OF THE SPECIES, THE PRODUCTION OF THE DISEASE, OR OF THOSE STATES OF THE CONSTITUTION WHICH ACT AS PREDISPOSING CAUSES, IS TO BE FULFILLED.

Whether it be admitted that tuberculosis may be engendered in the embryo, at the period of conception, under any of the circumstances described at page 389, or not, it is quite clear that those circumstances relating to the parents, tend to the production of a debilitated constitution in the offspring; and that debility in the constitution of the child will give more certain effect to the hereditary transmission, if either parent be tuberculous, and will of itself act as a predisposing cause, even if the parents are totally free from a tuberculous taint. In either point of view, therefore, it is incumbent on the medical practitioner, to adopt rules framed upon philosophical principles, for the prevention, on the one hand, of the innate production of tuberculosis, or, on the other hand, of that debility which predisposes the constitution to become affected

with the disease under the agency of its true causes. The more obvious rules which result from a consideration of the causes are the following:—

1. *To prohibit the intermarriage of members of the same family.*—We have already stated that where tuberculosis exists in the family in the slightest degree, consanguinity constitutes a ground for peremptory prohibition. Upon a more general ground, that of its tendency to degrade the species, and lead to that debility in the offspring which acts as a predisposing cause of this disease, such marriages should never obtain the sanction of the profession.

2. *To prohibit precocious marriages.*—The period of puberty, or the actual occurrence of menstruation, which precedes the termination of the growth and development of the body, and corresponds with the first awakening of the generative faculties, is not the proper period of marriage. The period of nubility, which succeeds to full growth and development, when the generative powers are in their complete vigour, is the proper period. Physiologists, and others, have endeavoured to fix this at different ages for different countries. Marc and Burdoch, avoiding the extremes adopted by Xenophon, Hesiod, Lycurgus, Plato and Solon, fix it at 24 years for men, and 20 years for women. Lugol considers that 25 years is the proper period for men. It is perfectly clear, that no arbitrary rule can be laid down. The important practical principle, in regard to tuberculosis, is, that marriage by either sex before the completion of growth and the full development of the powers and faculties is calculated to produce that kind and degree of debility in the offspring which lays the foundation for the disease.

3. *To prohibit marriages too late in life.*—The power of the reproductive faculties diminishes as age advances, and a period arrives when individuals are no longer capable of engendering robust children. Lugol states that the offspring decreases in vigour in direct ratio with the increase of years, until at length none but abortive embryos are generated (l. c. p. 68). "Parents cannot impart to their offspring the vigour which has departed for ever from themselves." Lugol fixes the commencement of this decadence at 45 years in men, and 40 years in women; and he considers the case is not altered when a woman past this age is impregnated by a young man. Holding an opinion at variance with that of Lugol, who regards this, and analogous circumstances in relation to sex, as direct causes of tuberculosis, but regarding

them as causes of that debility which predisposes the constitution, and becomes ancillary in its operation to the true causes of the disease, it may be affirmed, and although no arbitrary rule can be adopted, all experience establishes, that as age advances the offspring is liable to be weakly, and if either parent be affected with the tuberculous taint, it is almost sure, under such circumstances, to be transmitted to the offspring.

4. *To prohibit marriages where there is a great disparity of age.*—Lugol maintains that it is an essential condition, in the procreation of a healthy offspring, that the husband should be some years older than the wife, and that a disproportion in the ages of the parents, the father being younger than the mother, is a cause of "hereditary scrofula." It appears to us that isolated instances brought forward by this author, in support of his doctrines, are but of slight value. Statistical data are wanted to determine the real influence of most of these circumstances. At the same time, the principle must be admitted, in accordance with general observation, that a great disparity of age leads to debility in the offspring; and if tuberculosis exist on either side, the chances of children being born tuberculous is greatly increased by such disparity.

5. *To prohibit the marriage of paralytic, epileptic, lunatic, and other subjects of uncured or incurable nervous diseases.*—Without admitting the transformation of these diseases into scrofula or consumption, there is every reason to believe, that the progeny of such subjects are extremely liable to the tuberculous disease of the blood.

6. *To prohibit cohabitation under the influence of the causes of the disease.*—Although an approximative limit may be fixed to the transmission of the disease hereditarily, that is to say regarding it abstractedly, and totally apart from the continued operation of the original inducing causes, this limit and the extent and period of transmission become indefinite under *circumstances* and in *localities* where the causes continue in operation. It may be stated, as a principle founded upon the laws of generation, that tuberculous subjects should, as far as possible, avoid conception and gestation under such circumstances. Not merely on account of their own health, but for the purpose of preventing the operation of the hereditary law. If an individual of a tuberculous constitution be totally removed from the agency of the causes that have produced the disease, it is much less likely to be transmitted to the offspring; thus, a female born of tu-

berculous parents in a confined street in the metropolis and settling in the same part of the town, will transmit the disease to her children although she shall have escaped its active manifestation herself; whereas, other things being the same, if she removes to a more healthy locality, her offspring are more likely to be healthy, and the disease, as far as hereditary transmission is concerned, to cease in that generation. As respects the residence of a newly married couple, one of whom belongs to a tuberculous family, our opinion should be founded on this principle.

7. *To prohibit cohabitation during early convalescence after acute disease.*—The great probability that the newly formed blood is especially liable to the tuberculous transformation, in which case the disease would be transmitted to the offspring, renders this a rational precaution; but, independently of this, children begotten or conceived under such circumstances are liable to be weakly.

8. *To secure the perfect cure of any blood disease which is likely to lay the foundation either of debilitated or tuberculous children.*—This applies especially to syphilis; and equally to those about to marry, and to married people. In the latter case as in the former, where such affections unhappily occur, cohabitation should be prohibited until a perfect cure is obtained, and until the blood is completely purified and renovated. This is advisable for various reasons, but it is here insisted upon as necessary to prevent the debility which leads to tuberculosis in the offspring.

9. *To consider the period of conception in reference to the actual state of the blood.*—A great variety of considerations might be introduced under this head. The most favourable periods for conception are undoubtedly those of the most perfect health in both parents, or of the most complete remission or intermission of disease. The vigour or feebleness of the offspring, as well as hereditary transmission, depend upon the actual state of health or disease of the father or mother at the period of conception, and on this ground as well as the former all curable affections should be cured, or as much as may be, palliated by treatment.

As far as medical opinion may avail, where tuberculous local affections exist, the strongest reason obtains, not only for interdicting marriage, but for prohibiting the chances of conception in married people, until they are cured. The hereditary transmission and its consequences, as to intensity and degree, is much influenced by the actual state of the disease in either parent, at the *period of*

conception. Thus, external scrofula is more likely to transmit the tuberculous condition of the blood and organic tissues in an open state, and by curing the external disease the probability is, that the diseased condition of the blood will also be cured, and the chance of transmission prevented. So, also, we frequently observe that the first children of tuberculous parents, begotten before actual disease has manifested itself, escape; while those born subsequently fall victims to the disease.

There is only one other rule which I think it necessary here to refer to, and that respects the mother.

With a view to the health of infants the period of menstruation must be attended to. A woman may conceive at any period, either during or in the intervals of menstruation. Menstruation is a periodical depuration of the blood, and it is especially so in women of weakly and diseased constitutions. The health of the infant may be affected by the purity or impurity of the blood at the time of conception; and from this it follows, that the chance of conception should be avoided during the period of menstruation;—beyond this—if rational principles are acted upon, it would be better avoided for six or eight days immediately preceding the expected period of menstruation, even although the disposition to conceive may at this period be very great. The blood at this time is charged with principles which are intended for elimination, particularly in unhealthy females, and an infant begotten under the influence of this morbid condition must inevitably be subject to its influence; and its chance of inheriting the morbid state of the blood may be increased. The most favourable period of conception in healthy females is about the eighth day after the cessation of menstruation, from that to the fifteenth day.

Besides the rules here laid down, there are many others which might be deduced from the laws of generation and our knowledge of sexual influences and their effects. Lugol lays great stress upon sexual abuses of all kinds, and there cannot be the slightest doubt of their agency. To attempt to lay down rules for the purpose of meeting every case would be useless; it is sufficient to state here, that for the purpose of fulfilling the present indication, every circumstance which tends to deteriorate the reproductive faculty should be avoided, and that every disease implicating injuriously the generative functions, should, if possible, be cured.

SECTION III.

OF THE MEANS BY WHICH THE DEVELOPMENT OF THE DISEASE IN THE FŒTUS IS TO BE PREVENTED.

There can be no doubt that tuberculous germs derived from the father frequently die in the matrix, and are aborted, or if they do not lose their vitality they continue during uterine existence more or less impressed with the tuberculous type of constitution. There can be as little doubt that germs, whether tuberculous or sound, as derived from the father, may become tuberculous, or may have their tuberculous qualities aggravated by the material derived from the blood of the mother being tuberculous; nor can it be doubted, when the facts are accurately examined, that the degree and extent of the tuberculous nutrition of the fœtus depends in a great measure upon the degree in which the blood of the mother is tuberculous. Accordingly, when either the father or the mother, and particularly the latter, is tuberculous, even although only to the extent of a predisposition, the mother during her pregnancy is an appropriate subject for medical treatment. Mothers are not sufficiently aware of the immense influence which their own state of health, and the condition of their blood, exercises over their offspring during pregnancy. From the earliest moment of embryotic existence, the health and development of the fœtus must be mainly dependent upon the healthy constitution of the blood of the mother. It is highly probable that the hereditary transmission would be more frequent than it really is, and that the children of tuberculous mothers would come into the world with tuberculosis in a much more advanced stage of development than generally happens, but for a provision of nature whereby the vitality of the blood of females is increased during utero-gestation.

This section accordingly comprises the very important consideration of the treatment of a tuberculous subject during pregnancy. The question arises here in reference to the treatment of the fœtus through the blood of the mother, so as to secure the most healthy nutrition of the former; but it is really a question of the treatment of the latter, in reference to her own as well as her infant's welfare, and the subject *in extenso* must be referred to the next section.

It will suffice here to state, that the hygienic rules as to diet, aeration, the ventilation of apartments, exercise and clothing, and the general principles upon which tuberculous subjects are to be

treated, which will be described in the next section, are necessarily brought into requisition for the purpose of fulfilling this indication in reference to the fœtus in utero.

It becomes a question of very considerable interest whether the progeny of tuberculous individuals may be treated medically antecedent to birth through either parent; and in the first place, whether the fecundating fluid of the male can be influenced by medicines administered. Let us suppose a young man, born of tuberculous parents, exhibiting many of the characteristics of the tuberculous constitution; he marries with the prospect of immediately becoming the father of a child, and we know with certainty his liability to transmit the disease, although for the time being in his usual good health. Is there any medication in addition to hygienic rules which will tend to prevent this result? Our attention is at once directed to the preparations of iron; their decided influence over the composition and vital powers of the blood, and upon the generative functions, lead us to believe that they must influence the chemico-vital composition and the vital powers of the fecundating fluid. It would be rational practice to place an individual of such a constitution under the influence of iron, with a reasonable expectation that the remedy would have the effect of rendering the germ more stable and healthy, that the material, in the first instance supplied by the male, would be more adequate for the construction of the future embryotic fabric; that the vital power with which the future embryo is endowed, would, *ab initio*, be more likely to prove sufficient for all the processes of vitality, and that the laws of life would be more likely to operate in a right direction. These effects are probably promoted by the judicious use of chalybeate mineral waters.

Much may be done also to improve the development of the embryo, and the nutrition and growth of the fœtus in utero, by the medicinal treatment of tuberculous mothers. Analogous remarks respecting the employment of iron apply here as in the case of the tuberculous father, and as respects both parents, the use of cod-liver oil must not be overlooked.

SECTION IV.

OF THE CORRECTION OF THE PREDISPOSITION TO TUBERCULOSIS, AND THE PREVENTION OF THE DEVELOPMENT OF THE DISEASE AFTER BIRTH.

The question has been asked—"Is the eradication of the scro-

fulous diathesis a matter of probable facility?" Dr. Ranking gives a very unfavourable reply.* He believes that all the symptoms may be so amended as to afford the patient a tolerable share of health for the future, but questions whether it is ever eradicated to the extent of withdrawing the individual from the risk of procreating scrofulous children. My own experience leads me to take a considerably more favourable view than this. I believe, that if the principles of rational medicine were completely and consistently carried out, they are adequate to the accomplishment of this task. The difficulty lies in this, that these principles are too little relied on by the public.

That the predisposition to tuberculosis may be cured, and is repeatedly cured, by what may be termed spontaneous or accidental influences, I am perfectly convinced; or, if the expression "cured" be objected to, that it may be modified by the influences with which it is surrounded, to the extent of correcting the defective state of the blood, rendering the nutrition healthy, and destroying the unnatural proclivity to disease, and even of producing new predispositions, cannot be doubted. In illustration—take a child, born of healthy parents, and of a sanguine temperament, predisposed to diseases of over-nutrition—to plethora and entonic inflammation—let it be badly nourished, and deprived of good air, light and exercise, it will soon lose its original predisposition and its pristine tendency to disease, and will acquire a new predisposition and a new quality of organization, tending to another disease, or to another series of diseases; and although this instance is not strictly analogous, it shews the extent to which modifications may be produced in the organization and the state of the vital powers.

If the practitioner is to undertake the correction of the tuberculous predisposition, when hereditary, with the best chance of success, he must commence from the birth of the child; but at whatever age and under whatever circumstances, the principles of treatment are the same. His measures will be chiefly hygienic, but they must be persevered in with constant attention to the primary object in view—healthy hæmatosis. The mode of fulfilling the various indications will differ greatly, according to the period of life at which the treatment is undertaken; and the chance of success will in a great measure depend upon the existing vital

* Essay on the Treatment of Scrofula, appended to his translation of Lugol on Scrofula, p. 228.

qualities of the circulating blood; and the degree and extent of the malnutrition of the tissues; but there is this one great principle which ought never to be lost sight of—the treatment, hygienic and therapeutic, must be *adequate* to the result purposed—the immense power we possess of modifying the human constitution must not be lightly regarded. As the ancient methodists express it, the problem is to "*recorporate the whole body;*" but where the predisposition is hereditary, or whether hereditary or acquired, has existed for years, although the individual may be placed under the most favourable circumstances, an immediate thorough change cannot be expected; a rapid modification of the blood will be followed by an equally rapid improvement of the nervous powers, and by the subsidence even of many of the symptoms, yet the blood must continue more or less tuberculous until all the tuberculous structures have been renewed; and in some instances probably until every particle of the body has been replaced. Whether the tuberculous state shall progress or retrograde, or whether it shall proceed slowly or more rapidly, will depend upon the circumstances of the case, and especially upon the control we may have it in our power to exercise over the habits and customs of the individual; but the reversal of the tuberculous constitution is only to be effected by adopting a system of treatment in all its parts adequate and complete.

The principles of treatment, hygienic and therapeutic, of scrofula, and of tuberculosis in all its phases and degrees, before the actual deposit of tubercle, are the same; all the local diseases, truly "scrofulous" or "tuberculous," and the specialities or modifications of ordinary diseases or of the effects of remedies, owing to which such diseases are regarded as "scrofulous," springing from a condition of the blood essentially of the same nature, the principles of treatment of the constitutional affection apply universally; although their application may be rendered wholly or in part impracticable by contra-indications after the more severe forms of local disease have developed themselves; and although their beneficial effects, even if practicable, may in frequent instances be rendered nugatory by the existence of local disease.

The correction of the tuberculous predisposition is to be effected:

A.—By supplying the blood with its constituent materials in a state of purity, in sufficient quantity and in due proportion.

B.—By all such measures as are calculated to promote the elaboration of the materials of nutrition, the formation of healthy blood, and the elimination of effete matter.

C.—By all such measures as promote healthy cell-growth and a consequent vigorous nutrition of the organic structures, a symmetrical growth and development of every part and of the whole bodily frame, and a healthful waste and repair.

A.

The materials for the formation of healthy blood are received into the system by the respiratory and digestive organs.

I.—THE RESPIRED AIR.

The exact circumstances in which the relations of air and blood are disturbed in tuberculosis are yet unknown; nor are we certain, physiologically, what is received and given out by the blood; but the material most certainly supplied by the air we breathe, is oxygen gas, so essential to the vitality, in the first place of the blood, and secondarily of the whole living economy, that the infant, who, when brought into the world might live for a considerable period without food, would die in, at most, a few minutes, without air. For this reason, and also because aeration appears to be more directly associated with the true cause of tuberculosis (p. 439), I consider that, in relation to treatment, it demands consideration even before diet. It is by no means certain that the blood is not supplied with azote as well as oxygen from the air we breathe; but even if it be, we have no facts to indicate what part the azote may play in the formation or correction of tuberculous blood. The effect of the electric condition of the air is also as yet unknown. The oxygen gas has to be considered in a double point of view; 1st, as entering into the composition of the blood, regarded as a nutritive fluid; 2nd, as a principle to be conveyed throughout the economy, for ulterior purposes; especially for the production of animal heat, and the eremacausis and elimination of effete materials. In the present state of science, our principles of treatment, as respects the air which tuberculous subjects should breathe, refer to its purity from the admixture of foreign or deleterious materials; to certain physical properties which have a relation to the quantity received into the chest, as its temperature and weight; and to the continued renewal of the air respired.

When we undertake the treatment of a case of tuberculosis, the first question then relates to the circumstances and habits of the patient, as respects the air habitually respired; and this applies to all ages, and to the disease in all its varieties and forms. It is important to know the proportion of time daily spent by the patient within doors and out of doors, the number of hours spent within and without the sleeping room, the locality of the habitation, the size and state of ventilation of the sleeping room, the kind of bed, the mode in which the patient sleeps, and the character of the climate which he inhabits. If the result of this investigation should indicate, as most frequently happens, even where in the first instance it appears to be otherwise, that the patient is living in circumstances, as respects the air he breathes, grossly anti-hygienic, our first effort should be to ameliorate his condition in this respect. Take the case of an individual living in a close street in the metropolis; the air at the best is impure; suppose that his occupation confines him within doors upon an average 23 out of 24 hours, during six days in the week, and 21 or 22 out of the 24, on the seventh day; suppose, again, that he occupies a close sleeping room, and is enclosed by the drapery of a bed, seven out of the 24 hours; in this case he *never* breathes a pure air; about *nineteen twentieths* of his existence is spent in the impure and insufficiently renewed atmosphere of his offices and house; and more than one-fourth in the absolutely stagnant atmosphere of his enclosed bed and bedchamber. This is by no means an exaggerated nor an infrequent case. Our object should be to ameliorate this state of things, as quickly and to as great an extent as possible. The total removal of the drapery, an efficient ventilation of the bedchamber, an increase in its dimensions, a greater portion of time spent in the open air, a residence wholly or partly in the country, are so many stages of improvement; and if we cannot effect all that is desired, we must effect all we can. Carrying out the above illustration—if the patient were removed ten miles from his town residence to sleep; occupied a large well ventilated sleeping room; a bed without curtains; and took an hour night and morning to go to and from his place of business; the evils of the use of bad or indifferent air, in his case, would be reduced almost to a minimum; for it is to be observed, that the period during which he would now respire it, is that of mental and bodily activity in his occupations, when it is infinitely less injurious than during lassitude, fatigue, rest and

sleep; by the change we have indicated, the respiration of a vitiated and insufficiently renewed atmosphere is reduced from $^{19}/_{20}$ths of his existence to something between one-half and one-third.

It has already been shewn, that in tuberculosis there is no philosophical ground for the conclusion, that under the worst circumstances of aeration, the air does not contain a sufficient quantity of oxygen to oxygenate the blood; and, moreover, that there is greater reason to believe the nutritive material excessively oxygenated than the converse, although the blood may convey a smaller quantity of oxygen throughout the system; considerations which have no doubt produced scepticism as to the agency of bad air in the production of the disease; and indifference as to the application of the remedy. But, we have conclusive proof that respiration in an impure, stagnant, and insufficiently renewed atmosphere, is always attended with stagnation and insufficient renewal of the air resident within the chest; and it has previously been shewn, that herein lies the mischief; whatever the essential change in the nutritive material may be, and whatever elements may be concerned in it, oxygen, azote, or carbon, it is the stagnation within the chest which promotes the morbid change.

Although these considerations relating to the air of respiration have been illustrated in the individual, they admit of a most extensive application. They apply equally to families; and those who are tuberculous ought to be properly instructed on this vital point by their medical advisers. They elicit our vigilance also as to the aeration and ventilation of schools, workhouses, hospitals, prisons, barracks, ships, lodging-houses, &c., with a view to their improvement when occupied by tuberculous subjects, and to the modification of the habits, and the amelioration of the condition, of those tuberculous individuals who must necessarily reside in them.

As respects the rearing of tuberculous infants, or the children of tuberculous parents, and the eradication of the tuberculous taint, the chances are very greatly increased by residing altogether in the country. In truth, all attempts to rear them in cities and towns, notwithstanding the best diet, and attention to every other principle of hygiene, will often fail. Where their *home* must necessarily be in towns, every effort should be made to avoid their remaining entirely there; particularly after the slightest indication of external or internal scrofula. The strictest injunctions ought to be given as to the air of their sleeping rooms, and they should be

habitually exposed, as frequently and as long as practicable, to the open air. There is one precaution also which especially applies to infants, that the nurse be extremely careful not to allow them to sleep with their faces covered with clothing. As respects the posture, the bed clothes, and the bed on which the infant sleeps, while every care should be taken to secure the proper degree of warmth, there ought to be free scope for the play of the respiratory powers; keeping an infant warm with soft beds and heavy coverings, while the air it breathes is vitiated, and the action of the chest restrained, is a common and very pernicious mode of replacing the powers of nature by the contrivances of art; clothing should at all times be regarded as ancillary to the true process of respiration, the necessity for which it can never supersede.

For tuberculous children of more advanced age, it often happens that the most available and best plan is to recommend their being sent to school in the country or by the sea side. The principle of *change* is thus brought into operation, and there cannot be a doubt, that in the tubercular habit, the change of external stimuli, implied by the expression "change of air," is attended with the greatest advantages.

The too constant attendance of tuberculous subjects in the sick chamber ought to be vigilantly guarded against, and as far as medical opinion can avail, peremptorily prohibited. The air of the sick chamber is impure, and for the most part very imperfectly renewed, and even the robust and healthy are liable to suffer from its influence; but attention to this rule is especially demanded in cases of tuberculosis.

It has been stated, that in the opinion of some of the best observers (Laennec, Andral, p. 480), the idea of contagion in the ulcerous and suppurative stages, ought not to be entirely abandoned; but at the same time, if ever communicated, it can only be as an exceptional case, where the closest communication has taken place and that generally for a long period.

Fournet records (lib. cit., p. 870), that he knew a medical man, a good observer, whose wife died of tuberculosis pulmonalis; during the whole period that he cohabited with her he experienced all the *rational* signs of incipient phthisis, which disappeared gradually after her death, and never returned; he was of good constitution, free from any of the characteristics of tuberculosis, had always had good health, and led a regular life. I know a precisely analogous

instance. A medical man slept with his consumptive wife to within a week of her death; during the latter period of her life he lost flesh and strength, became anæmic, short breathed, and had night perspiration, with suffusion of the hands and a pink sediment in the urine; after her death these symptoms gradually subsided, and although this occurred twenty years ago, no signs of tuberculosis have occurred since.

M. J. Guérin gives the case of a woman who died of phthisis in the last stage; her husband, originally of good constitution, and free from any original or acquired tuberculous taint, having cohabited with her to the last, married a second wife, of equally good constitution; eighteen months after marriage he died of phthisis; his second wife, who cohabited with him till his death, married again, but two years subsequently she died of the same disease; her second husband, of good constitution, and free from any tuberculous taint, died also of phthisis, some time after the death of his wife. (Fournet, p. 871.)

These isolated cases, however, by no means prove the contagiousness of the disease; the coincidences may, with equal probability, be referred to the anti-hygienic influences to which the individuals are subjected (p. 480). The continued operation of the depressing passions, of confined air, of want of exercise, and other morbid influences, in those who nurse their sick relatives, are extremely likely, where the slightest predisposition exists, to bring the disease into activity; and to produce it in those who were previously healthy. The respiration of air strongly impregnated with the morbid emanations from ulcerous surfaces, as of scrofulous sores and cavities in the lungs, can but prove injurious to the most robust; and, if long continued, must produce a state of health, which at least powerfully predisposes to the disease; so that, apart from the doctrine of contagion, the utmost care ought to be taken that those who nurse tuberculous subjects have sufficient exercise in the open air; and sleeping with patients who have suppurating sores, whether in the lungs or elsewhere, ought to be peremptorily interdicted.

SOLAR LIGHT.

Tuberculous subjects, whether infants, children, or adults, require as large a proportion of solar light as can be given to them, and therapeutical considerations relating to light are generally associated with those which belong to the air respired. Exclusion

and insufficient renewal of air is usually accompanied with obstruction of light; in cellars, ill-built and ill-ventilated houses, narrow streets, dense towns and mountain vallies, this is obviously the case; and the remedy of the one includes that of the other; but there are some considerations which relate to light more particularly.

The deprivation of the solar rays by the customs of society and of families, beyond what the geographical position of the country produces, becomes very injurious to the tuberculous constitution; and a powerful ancillary cause of the production of the disease. In the winter season, even when, in a large city, the rays of the sun are obscured and dimmed for weeks together, the last rays are excluded by the closure of apartments, late hours are kept, and a proportion of the population remain in a darkened bedchamber for several hours after the sun rises; from these causes, and from remaining wholly within doors during the inclement season, many persons, children and adults, are continually deprived of the genial influence of insolation for months in succession. Even in the summer, the same customs prevailing, the period of darkness, which nature intended for sleep, is made the period of amusement, or of study, by the aid of artificial light; and a little before the sun rises in the morning, the inhabitants of our large cities have just retired to rest in completely darkened chambers. Several hours of the sun's influence are thus voluntarily rejected. This is not so much the case among the peasantry and in country places, and with them the amount of insolation is from various causes much greater than with the inhabitants of large towns; at the same time, tuberculosis is a less frequent, and, we believe, a less inveterate affection. Without attaching more importance to the influence of light than science warrants (p. 423), it is perfectly clear that tuberculous subjects ought to be exposed as much as possible to the light of day; they ought to sleep in light as well as airy apartments, and this rule applies as well to infants as to adults.

The subject of the relations of air and blood in the hygiene of tuberculosis involves:—

THE LOCALITY AND ASPECT OF DWELLING HOUSES.

Where the object is to preserve the health of tuberculous subjects and to improve their constitutions, this is by no means a trivial matter, and it embraces various considerations.

The locality of the street and the part of the town in which a tuberculous subject resides, may make all the difference between the probability of treating a case with success or not; when the residence of such a subject is in a small, narrow, ill-ventilated street, in a densely inhabited part of a town, we should recommend removal to a more open locality. This remark applies to the poor rather than to the rich, or even to the middle classes, who are necessarily stationary, but among the better class of artizans there is frequently no difficulty, where the will exists, in carrying out such a recommendation. The great subject of regret is that the houses of the poor are not located with a greater regard to the requirements of health.

The aspect of the dwellings, and even of the room in which tuberculous subjects sleep, is of importance. On this point there is too much apathy, both in and out of the profession. A very forcible illustration of the influence of aspect is to be met with in Dr. Young's work on consumption (p. 103). Dr. Carrick, in his observations on the influenza of 1803, remarks that "one of the most open and exposed of the buildings on Clifton Hill is Richmond Terrace, which forms three sides of a parallelogram, from respectively the East, South, and West; on the East side not one family, and scarcely an individual, escaped the complaint, while on the South side a great majority both of persons and families, in all other respects similarly circumstanced, escaped it entirely." In my own practice I have continually derived the greatest advantages from having the bedrooms of tuberculous patients changed from an Easterly or Northerly to a Southerly or Westerly aspect. I have found that the liability to local attacks, as of coughs, colds, and glandular affections, both in children and adults, has been greatly diminished by such a change.

In country places there are other considerations. Dwelling houses should not be too closely nor too densely surrounded with vegetation. In connection with air and light the influence of moisture has been described (p. 434); trees attract and condense moisture from the atmosphere, and as long as the surrounding air continues saturated they retain it, but exactly in proportion as the atmosphere dries they give it up again; accordingly, in a damp climate like our own, not only on account of obstruction of light and air, but as means of increasing moisture, houses too thickly and too densely surrounded with trees should be avoided. The

slopes of hills rather than the vallies, even in our own climate, where the hills are nowhere but of moderate altitude, are to be preferred, and more so in mountainous countries; radiation is less, the condensed vapour which falls from the atmosphere, as well as the rain which has already fallen, are precipitated into the valley, and stagnate there much longer than on the slopes. The most desirable site for houses is an elevated situation on a dry soil, with many windows, so as to ensure full insolation and sufficient ventilation; and with all lofty trees, whether ornamental or otherwise, so far removed from the building that the air and light cannot be obstructed.

These observations may appear trivial, but attention to them is absolutely necessary in every case where the correction of the tuberculous constitution in individuals or families is to be seriously undertaken.

The necessity for the respiration of pure atmosphere, and for as constant exposure to the open air as possible, by tuberculous subjects, and other considerations, renders a change either temporarily or for a permanency, from the impure atmosphere of towns to the better air of the country, or from one locality to another, an important remedy, and this leads to the consideration of:—

CLIMATE IN THE TREATMENT OF TUBERCULOSIS.

The etiological influence of climate has been considered in a former part of this work (p. 508); and many of the facts and statements there recorded are applicable to the question of its influence in the treatment of the disease. The greatest differences of opinion exist upon this subject.

It has for a long time been very much the custom to send tuberculous subjects, and particularly those affected or threatened with tuberculosis pulmonalis, to a foreign climate in search of health. This has been done, to accomplish the objects already mentioned; and also from the notion, that certain climates possess an immunity from the disease, and a specific curative power. The dubiousness of the truth of these latter opinions, even as respects the most salubrious climates on the globe, has been explained (ch. V. p. 537).

The question of climate, as a therapeutical agent, includes that of *change of air* in the native climate of the individual; but this must not be regarded in exactly the same point of view as migra-

tion to a foreign climate. We derive advantages in numerous cases from sending a patient to a more appropriate residence in his own country, in reference to the state of his case, and the season of the year, when it would be manifestly improper to send him across the sea, and to a foreign climate. The greatest benefit frequently accrues from change of air, to individuals even with cavities in the lungs, when it would be a simple act of cruelty to send them abroad.

That very great disappointments are continually resulting from the expatriation of consumptive patients, and that very serious mistakes are made, we have ample testimony. Such disappointments have often resulted among ourselves from sending patients from this country to Italy, Madeira, the South of France, Malta, and other places; the American practitioners have often been disappointed on sending their patients to the Southern States; and our Continental neighbours from the effects of change of air to Hyères, for instance, or migration to the West Indies. Dr. Hull, in a recent little work which contains some very important practical remarks,* enquires whether he is not justified, from the history of the past, in saying, "that all expatriation is vain;" and he also makes the remark that "our own islands contain every various advantage of air, from Devon, where the roses bloom in winter, to parts of Scotland, which, for bracing air, rival the Pole." The purpose of Dr. Burgess's volume (lib. cit.) also, is to show—"that to send consumptive patients to Italy, or to the South of France, for the benefit of their health, is a mistake; and that the climate of the United Kingdom, as yet very partially and imperfectly understood, will afford to the English consumptive invalid as great, if not greater, chances of recovery than that of either of the former countries, provided a proper locality be selected." I have already referred to the differences of opinion which exist as respect the effects on tuberculous subjects of emigration to India (p. 514). In Dr. Allen Webb's work, several times quoted, after describing the frequency, in Bengal, of tuberculosis of the bones and lungs, the following remarks occur, by Dr. Green :—

"I have seen so much misery in private families, and so much harm in the public service, arise from the false views that prevail respecting scrofula and consumption being benefitted by a tropical

* A Few Suggestions on Consumption, by R. Hull, M.D. 1849.

climate, that I feel bound to state my conviction that Bengal, at any rate, is most fatally inimical to these diseases. I have seen medical men, clergymen, officers in the service, &c., who have told me, when surprised with the fatal turn of these diseases, that they expected to *get well here*. I have seen young and beautiful European ladies carried off with appalling celerity. I have seen quite young soldiers, who, if they do not quickly die, are sent home wholly unfit for this or any other service. I have visited Penang and Singapore, nor can I think, from my observations *there*, that they in any way retard the fatal issue of consumption. I have known a whole family lost at sea, father and children, all, in accompanying a mother whose latest sufferings could only have been painfully aggravated by being sent to die in so far a land." *

Mr. Power also states of those who go to Van Dieman's land, that "so far from being benefitted by the change of climate, voyage, &c., to which they have been thus subjected, the course and development of the disease seems to be considerably accelerated, and a fatal termination to ensue at a much earlier period than would probably have occurred had the sufferer remained quietly at home. This point is mentioned chiefly because sea voyages have been recommended, on very high authority, in incipient or threatened cases of phthisis pulmonalis; no doubt this advice was intended to apply only to voyages made in the temperate zones, and the effects of a tedious voyage, no matter how perfect the accommodation on board, through the high latitudes south of the Cape of Good Hope, where during the greater part of the year the weather is cold, wet, and foggy, were not contemplated."†

The evidence here brought forward is by no means sufficient to contravene the opinion at present entertained, that great advantages often result from change of climate and change of air to individuals affected with tuberculosis uncomplicated with local disease; and even where local disease exists, but where the primary blood disease is not yet complicated with its secondary results. The main question is, whether, in such cases, as much benefit may not be obtained by a change from one locality to another, in the patient's native climate, as by expatriation.

Change of air, or change of climate, is indicated to obtain the

* Pathologica Indica, Dr. Green's Report, page 128.

† Mr. Power on the Climate of Van Dieman's Land, lib. cit., page 88.

advantages which result from a change of stimuli, and an improvement of the atmospheric medium, but in prescribing it we have to bear steadily in mind the characteristics of the blood disease. In the summer season, the object is to obtain a purer, cooler and more elastic air, so that the patient shall escape that life of lassitude, langour and muscular immobility to which tuberculous subjects are so prone in a high temperature, and that the functions of respiration and muscular motion should be normally performed. It is indicated also, when the disease is insidiously but manifestly progressing, notwithstanding the measures adopted to arrest it; when it is found to be totally impracticable to modify the hygiene, or improve the habits of the patient, while at his own home; and when there are qualities in the climate, season or locality, obviously exerting injurious influences. One material object to be attained, in the treatment of tuberculosis in this country is, by such a change, to enable the patient to take more exercise in the open air, and to have the advantage of a warmer, lighter, dryer and more equable atmosphere during the autumnal, winter and spring months; and another most important object is, where the respiratory surfaces are affected, or indicate a disposition to become so, to escape the injurious effects of the easterly and north-easterly winds in the spring season of the year.

For the choice of climate in the treatment of tuberculous cases, no absolute rule can be laid down; various and complicated considerations, in the treatment of such a disease, render it necessary that every case should be considered in reference to its own merits; and every climate or locality as to its peculiar qualities in relation to the case for which it is recommended. It is only necessary to revert to the schedule of the various forms which the disease is liable to assume (p. 630), and to look to the different tendencies which the symptoms of each case may indicate; to the glandular and cutaneous tendency of the one case; the laryngeal and bronchial tendency of another; the pulmonary or the mesenteric tendency of a third and a fourth; or to the actual existence of these forms of disease; in order to estimate the impracticability of prescribing any particular climate for all cases. Much depends upon the vital condition of the respiratory passages. Experience shews that one individual improves in a soft, moist air, and another in a dry, bracing air. In my own experience, where tuberculosis tends to external disease, I have found the advantages of the latter, and

occasionally where it tends to internal disease, of the former. We may often predicate, by the state of the constitution, which kind of climate will agree, but the feelings of the patient and his own experience, and close observation of the effects, must be acted upon; our curative principle is "peremptorily to prescribe air," and to endeavour to select such a locality or such a climate that the patient may be out of doors "all the hours of the day, and all the days of the year."

It would be futile, under this head, to attempt anything beyond a few general remarks. It may be stated, that those who become tuberculous in a foreign climate are generally benefitted by a return to their native country; but even such a rule cannot be acted upon uniformly, since exceptions must be made in those instances where the qualities even of the native climate are decidedly inimical to the case. Upon the same principle and with the same qualification some patients derive immediate advantage on a return to their native place from another locality in the same climate. It is a matter of common observation, that those who are hereditarily predisposed to the disease, naturally weakly, and have lived from their birth, for instance, in a mild, unirritating air, do not bear a sudden migration to a climate where the air has opposite qualities, however salubrious the latter may be in the abstract.

Bearing in mind the state of the blood and of the nervous powers and functions of tuberculous subjects, with their low power of sustaining animal temperature, it may be stated as one of the most general rules, that the injurious effects of humidity and cold must be constantly regarded. Nothing can be worse than a constantly moist and stagnant air, in a low situation, surrounded with trees and woods, so as to obstruct both the air and the solar rays. One great desideratum is *uniformity* as respects pressure, moisture, and temperature; and another, freedom from pernicious winds. A rarefied, light, comparatively dry, equable atmosphere is to be preferred. As respects temperature, both theory, and the facts contained in this work are highly in favor of an atmosphere that is moderately warm, but they clearly indicate that a cold and dry climate is far preferable to one that is intemperately hot and moist.

The foreign climates—to which patients have been most frequently sent for the cure of tuberculosis are Madeira, the East and West Indies, the South of France, Italy, Egypt, and Malta.

It is quite impracticable to enter into the comparative merits of the various countries and localities that have been recommended for tuberculous invalids; for this I must refer to the various works extant, and particularly to Sir J. Clark's treatise on the "Sanative Influence of Climate." This part of the subject must be limited to a brief recital of the considerations relating to the climates and localities to which my own attention has been practically called during the last few years.

Sir James Clark is extremely favourable to Madeira as a winter resort for the consumptive invalid of this country, and has, I believe, for many years, been in the habit of recommending it; his experience of the effects having confirmed its utility. He considers it preferable to any climate in the South of Europe. Its good qualities consist in—the mildness of the winter; the coolness of the summer; the remarkable equality of the climate by night and by day, as well as throughout the year; the small annual range of atmospheric pressure; the air in general being near the point of saturation with moisture, and hence soothing; being almost exempt from keen, cold winds, with regular sea and land breezes, and north-easterly winds during the summer, maintaining it in a temperate state; with neither smoke nor dust to impair its purity; an absence of fogs; and the soil dry, consisting mostly of the *debris* of volcanic rocks.

Sir J. Clark, Dr. Heineken, Dr. Renton, and many of the continental physicians, recommend this island as a means of *preventing* and not for the purpose of *curing* confirmed consumption. Of those who are sent there with suppurating lungs, and remain, nearly all die in as short a time as they would have done at home; and many probably much quicker. Of 108 patients "threatened with pulmonary disease," 93 remained free from symptoms, 13 fell off, and 2 were lost sight of. It does not appear how many of them had tubercle actually deposited in the lungs; probably a considerable proportion; but it is fair to presume, that nearly the whole were affected with the tuberculous condition of the blood, and these statistics are extremely favourable to the opinion that a residence in Madeira is beneficial when judiciously resorted to, and as far as the blood disease is concerned.

Dr. Mason, being affected with phthisis, resided two years in this island, in the expectation that it would cure him of the disease. He employed his time in making minute meteorological observa-

tions; and arrived at conclusions very adverse indeed to the climate as a resort for the consumptive invalid. He describes the atmosphere as saturated with humidity during the greater part of the year; being in this respect worse than London; since the temperature is higher than London it is capable of containing a very much larger quantity of moisture, and is on this account more injurious to the organization; it is subject to the *Leste,* a hot, dry wind, of a highly stimulating and exhausting nature; from its dampness it is impossible to keep iron, in any form, from being rapidly oxidized; and deliquescent substances are rapidly imbued with moisture; in a series of years it is subject to very frequent and remarkable variations of climate; and no more to be relied on than any other place for certainty of fine weather; and it has equally its annual variations of temperature; neither is the sky so transparent and cloudless as has been reported. Dr. Mason confirms Dr. Gourlay's statement, that consumption and scrofula are frequent among the natives. The author died of consumption in his journey from Havre to Nice in search of a better climate.*

There can be no doubt whatever that many tuberculous subjects are benefitted by migration to and from Madeira; but the contradictory statements respecting the qualities of its climate only confirm the view we have taken, in the chapter on etiology, that it is not the climate but the change of habits which produces the benefit. During the last few years I have known several tuberculous individuals who have been to Maderia, and returned with their health comparatively restored; but on questioning them, I find, that they have lived twice or thrice as much in the open air as they were accustomed to do, in corresponding seasons of the year, at home; they have also taken infinitely more exercise, and that of a gentle and salutary kind; they have been relieved of many of the harassing cares of life; and they have followed out judicious instructions as to their diet and general habits. I have been informed of others, who have gone there under equally promising circumstances, but have fallen into irregularities and dissipations; have adopted the converse of these hygienic customs; and have not only received no benefit, but their disease has progressed even more rapidly than if they had remained at home. In Dr. Mason's case it is to be feared that the disease was too far advanced to be benefitted permanently

* A Treatise on the Climate and Meteorology of Madeira, by the late J. A. Mason, M.D., 1850.

by any change of climate, and it is doubtful whether he would not have lived longer had he remained at home.

The ineligibility of Italy, the South of France and Malta, for tuberculous patients, has been recently dwelt on by Dr. Burgess, who is by no means singular in his opinions. I have had occasion to deplore the loss of friends sent hence in search of health, never to return. The bills of mortality in many of these countries are quite sufficient to indicate the futility of such a resort. There are undoubtedly localities wherein the climate is agreeable to the tuberculous constitution, but in almost every instance where this is the case some countervailing evil exists. As respects the West Indies, from the authorities quoted by Sir J. Clark, no benefit arises in unequivocal tuberculosis, particularly in the pulmonary variety; the disease proves fatal sooner than in a cooler air, and this effect appears to be produced by the continued high temperature. The testimony, however, is strong in favour of this tropical climate as a prophylactic; the disease is said never to originate in individuals arriving there in "perfect health," whether predisposed or not, and many authorities recommend the climate to those who are hereditarily predisposed, but it is difficult to credit the propriety of this in face of the facts relating to the army, recorded in Tables XXVIII and XXIX. Sir J. Clark observes, that much depends upon the nature of the patient's constitution, and suggests, that while it may prove injurious to young, feeble and irritable individuals, it may prove useful where tuberculosis sets in in more advanced life, the nervous system being less irritable; but it is only a certain proportion even of the predisposed who are likely to be benefitted.

Egypt, and particularly Upper Egypt, is perhaps the best foreign winter climate known for tuberculous invalids. It is moderately warm and equable in temperature; dry and elastic, the sky bright and cloudless, the atmosphere pure, transparent and exhilarating, there is little rain, no frost or snow, and dew is seldom seen. Its greatest defect is a remarkable fall of temperature during the night, rendering care necessary, on the part of the invalid, to avoid the injurious influence of its chilling effects. It is liable also to wind, and to vermin and dust. Clot Bey has seen many persons cured of consumption who arrived there labouring under the disease, and others materially relieved. Dr. Cumming, who passed a winter in Upper Egypt, advises all persons disposed to consumption, who are

liable to catch cold on slight exposure to damp, to resort to the Nile during the winter, but it is not adapted for the invalid whose disease is far advanced; (Clark on Climate). From the tenor of Sir J. Clark's remarks I gather, that he would recommend it unhesitatingly to individuals labouring under uncomplicated tuberculosis, or where tubercular deposit has produced no secondary results on the general system; although it is unsuited for delicate or sensitive individuals unable to bear considerable inconveniences.

Change of climate is contra-indicated, by every philanthropic and medical consideration, when internal local disease is far advanced, when hectic fever is established, when suppuration is in progress, and when the patient is reduced to that kind and degree of debility which will prevent those changes of habits and customs that form the essential element of the curative agency of the measure (p. 541). From the tenor of Dr. Burgess's observations (lib. cit., p. 20), I believe he condemns change of climate at all for tuberculous invalids. "Change of air in his own climate, or removal to one nearly approaching to it, is the natural indication, and will effect whatever good climate can effect in consumption" (lib. cit., p. 21). I lean very much to this author's opinion, believing that, as the treatment becomes better understood, we shall find localities in our own climate better suited for our own population, in all stages of the disease, than any abroad. It appears to me, that the enunciation of the indication to be fulfilled by change of climate, or change of air, requires revision. The *primary* object should be—to place the patient in improved circumstances of hygiene, and he ought to be informed that it is not the climate we trust to *mainly*, but a change in his habits of life; the facts contained in the chapter on etiology in this work, and particularly in the section relating to climate, amply support this view of the case.

Localities in England suitable for Tuberculous patients. — The south coast, the south-western coast, and the west of England are the localities which have been most resorted to in this country. The two former, as compared with London and the more easterly and northerly parts of the island, are characterized by mildness and humidity. Torquay is sheltered from north and north-easterly winds, and has a winter temperature several degrees above that of London. Penzance is more exposed to winds, but still warmer, moister, and less subject to variation. Illustrative of the climate of the latter place, the myrtle and camellia flourish in the open air,

proving the mildness of its winter; the temperature of the air at night averaging 7° above that of London. Its beneficial influence is sometimes experienced by patients for whom a moist atmosphere is desirable, but this has reference almost altogether to certain forms and stages of pulmonary disease, and in many instances the whole of these localities are injurious, owing to the relaxation and debility which they occasion.

For the renovation of tuberculous blood, it cannot for one moment be held, that such localities are to be preferred. Any advantage we may gain by the patient being more exposed to the open air, is often more than counteracted by the debility which it induces. The advantages are mainly, if not wholly, due to the effect on the pulmonary organs at the expense of the constitutional disease. Tuberculous subjects without pulmonary disease, or those affected with external scrofula, are not only not benefitted but frequently injured by a residence there.

For tuberculosis simply considered, in my experience, the South is far preferable as a winter resort, but in many cases, even where incipient deposit of tubercle has taken place in the lungs, and especially in external glandular and other scrofulous affections, a dryer, more bracing, but still a mild situation is required, and the higher or the lower parts of Clifton Hill, according to the season of the year, or Malvern and some localities of Wales, supply these requisites. There are numerous sheltered and salubrious inland situations which ought to be preferred, in many cases, to those already mentioned, as Tunbridge Wells, &c., some of which offer the means of fulfilling particular indications, owing to their mineral waters and other circumstances.

The localities to be preferred on the South coast are Hastings and the Undercliff. Hastings is recommended as a winter residence for tuberculous subjects on account of its mild climate and sheltered situation; particular parts of the town are very effectually protected from northerly and north-easterly winds. It lies low and has an atmosphere more completely marine than most other places on the coast, owing to the manner in which it is surrounded by high cliffs. Sir J. Clark does not mention it very favorably; nevertheless it is much frequented, and is recommended from November to the end of February. My own experience of it is, that where a marine atmosphere does not disagree, patients are generally very much benefitted by spending the winter there; but

I have known several instances in which the air appeared to be too stimulating, and pulmonary affections have been aggravated. I have known at least two, if not three instances, in which patients have gone there with tubercles in the lungs in a quiescent state, who have had intercurrent inflammatory attacks which produced their deaths in a few weeks.

Dr. Martin is the latest author who has described in the most favorable terms, the beneficial effects of the Undercliff, Isle of Wight, as a winter residence in tuberculosis, before the manifestation of local pulmonary disease by stethoscopic signs, and generally during the earlier stages and in the more curable forms of the disease. The advantages of this locality are derived from its particular *south-easterly aspect*, owing to which, during the whole winter the rays of the sun, from rising to setting, are upon it; its *inclination*, which allows the sun's rays to fall at a less oblique angle than on a plane surface, thereby rendering it warmer; the *reflection of heat* from the naked rocks; the *protection* afforded by its heights against the effects of pernicious winds; the *irradiation* of the rays of heat during the winter from the soil, heated during the previous summer; and from the proximity of the British Channel, moderating the heat of the summer, and tending by its influence to soften the rigour of the winter season. Under these circumstances, the mean annual temperature is at least 51° 72''; and it is characterized by remarkable *equability*, as respects different years, and also as respects the mean extreme range, in which it has a superiority over Madeira in the winter months; it has also a lower mean successive daily range.* The mean atmospheric pressure also, in a period of ten years, according to Dr. Martin, is somewhat lower than in London or in Devonshire; the extreme annual range is less than in London, and the mean yearly range is less than at Exeter, although the converse is the case as to the mean monthly range. The extreme range for ten years is 2·16 inches, while that of London is 2·40 inches.

The Undercliff, in consequence of the dryness of its soil and good drainage, is dryer than most marine climates of a similar character.† The usual amount of rain-fall is less; the rocks to the north attract the clouds and favor the descent of the rain; the mean annual fall of rain is given at 25·94, varying from that of London a little more than an inch, and the fall for Devonshire

* The Undercliff of the Isle of Wight, by G. A. Martin, M.D. 1849. † Idem, p. 92.

being 32·65 inches; more rain falls during the night than in the day; snow does not often fall, nor remain long on the ground, and the quantity is rarely great. South-westerly winds predominate in all seasons of the year. Sea fogs are less prevalent than on most parts of the British coast. It is remarkably free from thunder storms. Finally, in addition to the above advantages, the Undercliff enjoys the full influence of the solar *light*, particularly during the *winter* season.

The Undercliff, in fact, presents immense advantages for the tuberculous invalid. It is impossible to do justice to Dr. Martin's description in this work; but I cannot refrain from recommending those of my professional brethren, who have not read it, to do so before they determine on the expatriation of their consumptive patients. It is a climate, in which there are "few days" during the winter in which an invalid may not take *exercise out of doors;* according to the views I entertain, and will presently state, I should say, almost *none;* and he may do so within a short time after rain has fallen; the extent of sheltered ground for exercise, either walking, riding, or driving, forms a prominent feature in its advantages.

Dr. Martin states from experience, that the beneficial effects of this climate in tuberculous affections, as glandular enlargements, diseased joints, scrofulous wounds, necrosis, and phthisis, are annually witnessed; but he does not recommend it as a residence throughout the year; the invalid months are from the beginning of October to the end of June or July, and a change is necessary during the summer and autumn.

Change of air is a remedy applicable, in the first place, to the cure of the blood disease, and in the second, to the cure or relief of the local manifestation. It may happen that the kind of climate suitable for the one is injurious to the other. I have no doubt that the climate of Canada proves highly beneficial to many tuberculous subjects where the lungs are free from the disease, and in some cases even of tuberculosis pulmonalis; and that the climate of Norway would be the same; but where the pulmonary structures are highly irritable, and the native climate of the patient is mild and unirritating, a change to a sharp, cold air, however light, dry, and generally salubrious, could but be attended with risk in all cases, and must in many precipitate the fatal result.

My remarks on climate apply especially, in accordance with the object of this work, to the treatment of the disease of the blood; but they are also applicable to the treatment of all the tuberculous local affections, the cure of which is mainly dependent upon the treatment of the constitutional affection. When organic diseases of the viscera occur, originating new indications and contraindications, the problem of change of air or climate becomes even more complicated. In the first stage of tuberculosis pulmonalis, the principles of treatment of the general disease are mostly applicable, but as the disease in the lungs progresses, other considerations arise which cannot be embraced here.

A marine atmosphere.—Sea air has been lauded and condemned as a remedy for this disease, both by a residence on the coast and by voyages.

Laennec, and many other high authorities, extolled a residence on the sea coast for the improvement of the health for tuberculous subjects, and as a prophylactic against, if not a cure of phthisis. Laennec remarks that both ancients and moderns agree, that consumptive patients have been more frequently known to recover in consequence of a residence by the sea side, particularly in mild and temperate climates, than in any other locality; but Dr. Forbes * questions the extent of Laennec's experience on this point; remarking, that after a residence of five years in Penzance, his belief is, that the climate was unattended with any beneficial effects in phthisis;—but in a few cases of young persons, in whom the hereditary predisposition was well marked, if there was not already evidence of recent tubercles, a great and striking improvement in the general health and strength followed within a short period after their arrival, and seemed fairly attributable to the combined influence of change of air, scene, and climate. Dr. Perceval in this country, and Dr. Lush in America, were of opinion that a residence on the sea coast is injurious in consumption.

Beneficial effects of a marine atmosphere, have been attributed to uniformity of temperature, and of the degree of moisture, and to the impregnation of the air with saline matter, iodine, or both. But nothing certain has been made out on these points. A very great difference of opinion prevails as to the advantage of sea air in the scrofulous varieties of the disease; by some it is most highly extolled; by others, the improvement which frequently

* Translation of Laennec's Treatise on Diseases of the Chest, 3rd ed. p. 372.

results is referred to other causes, as bathing, exercise, change of situation and amusements; and among the poor, to an improved diet. Mr. Phillips has discussed this subject very fully (lib. cit., p. 290). He very fairly remarks, that we have no proof that those who reside at the sea side are more free from scrofula than those who live inland, and quotes authorities to shew the contrary. By Table XXVI (p. 521), derived from this author, it appears, that in this country, the deaths from scrofula are in greater proportion to the population in sea side towns than in inland towns, although the deaths from consumption are fewer; but in the northern districts of the United States the deaths from consumption are greater at the sea side than inland. (p. 535.) Dr. Ranking remarks, from his own experience, that "those who have had occasion to treat this disease (scrofula) both at the sea coast and in an inland district, will readily admit the important aid which they have derived from sea air and water." (lib. cit. p. 243.)

Sea voyages in temperate and warm latitudes—have been still more highly extolled than a residence on the sea shore. After quoting Aretæus, Laennec stated his conviction, that in the actual state of knowledge in his day, there was no better means to oppose to the disease; and he always recommended, either a sea voyage or a residence on the sea shore, whenever practicable. A long list of the most celebrated physicians and surgeons might also be quoted in favour of this measure. The fact that so many Europeans go to India and escape the disease, has often been referred to the effects of the voyage; so also the frequent improvement of the health on emigration to Canada, has been referred to the same cause; but since the adoption of the overland route as respects the first case, this explanation is in a great measure invalidated. The beneficial effects of sea voyages have been attributed to the qualities of the marine atmosphere already described, to a more equable and a negatively electric state, and to other causes.

My own observation of the results of sea voyages has convinced me how much depends upon the hygiene of the vessel, and the circumstances of the patient's case. In simple tuberculosis, or where there is no local disease, which prevents the patient exposing himself freely to the open air, and his animal spirits are such that he is not likely to become the prey of the depressing passions, I have no doubt that the change in the physical and moral life of the individual during a sea voyage, in a commodious and well provided

vessel, affords unequivocal benefit, and may arrest the development of tubercles, or retard their course; and in some instances may promote their cure. But where the converse of these circumstances obtains, the result is not beneficial, but injurious. Many tuberculous subjects, during even a short confinement to the air of a close cabin, leaving their native country under inauspicious or depressing circumstances, have had tuberculous affections rapidly aggravated; suppuration has increased, new crops of tubercles have been deposited, and the disease brought to a fatal issue much quicker than if they had remained at home. Even an ill-advised voyage to Madeira has not infrequently been attended with this effect.

Mountain air.—Contradictory opinions are entertained as to the advantage of mountain air in different forms of tuberculosis. On the one hand, the sickly frames and sallow complexions of the inhabitants of the Pontine marshes and of the plains of Italy, have been compared with the ruddy complexions and robust limbs of the Alpine peasantry; on the other hand, the question is asked, how can we expect advantage in localities where goitre, cretinism, and various forms of scrofula prevail? One mountain climate, however, differs as much from another as the climates of different latitudes. The greatest differences imaginable result from elevation; and minor differences from aspect and locality. At a moderate elevation the atmosphere surrounding a mountain may be saturated with moisture, whereas at a greater elevation it may be comparatively very dry. In certain localities in the Swiss alps, the sun frequently shines brightly, while the clouds may be seen at a lower range deluging the plains; and the vapour in the higher ranges is precipitated as snow, leaving the air constantly dry, light, and elastic, although cold; while in the less elevated ranges, the air is surcharged with moisture, and the valleys are soaked with rain. These facts are sufficient to show that we must not generalize too much even as respects mountain air, but must look into the merits of each locality.

The purest mountain air agrees with a large proportion of tuberculous subjects, unless severe local disease has supervened, and then it is generally too sharp. This kind of air agrees well with those who, having been originally robust, have acquired tuberculosis by sedentary occupations, and other antihygienic influences, particularly if such a climate be natural to them.

Dr. Burgess has given, what we can but consider as an illustration of the effects of mountain air, at the baths of Panticosa, already referred to (p. 536). They are situated at the head of a mountain valley; the climate is mild when the north wind does not blow; and extraordinary cures are related; respecting which, however, from the author's tone, we suppose him to be incredulous. The diminished frequency of tuberculosis in the plains and table lands in India have been recorded from Dr. Balfour's statistics (p. 532).

I have also several times referred to the effects of the mountain air of the Andes (pp. 80, 536). Those affected with pulmonary disease are cured by a residence in situations 5,000 to 10,000 feet above the Pacific. For the removal of the cough and other symptoms, the native practitioners recommend an excursion to Sierra, and no fact appears to be better established, than that this change of air and locality is the chief means of recovery. A tour to the inland valleys is attended with immediate relief, when any invalid, no matter of what age, sex, or condition, is much emaciated and subject to a short, dry cough, uneasiness between the shoulders, and a febrile pulse;—symptoms which usually indicate incipient phthisis; and a residence in the interior for several months or years, as the case may require, frequently secures a permanent recovery.

Our countryman, Dr. James Blake, well known as a physiologist, describes the salubrious qualities of the mountain air in California, about 2,500 feet above the level of the sea, in the same parallel of latitude as Rome. Very few cases of either phthisis or scrofula are met with, and the disease is more amenable to treatment than in any country in which Dr. Blake has practised. The general health of the community is of the highest character.* After a residence of a few months, an increase of weight takes place and the countenance assumes that ruddy tint, the most unequivocal sign of health in the Anglo-Saxon race. So, also, in Upper Canada, as in the vicinity of Guelph, an elevated region, it is reported that a scrofulous or consumptive case is scarcely ever seen, and tuberculous families from England, many individuals having exhibited alarming threatenings of phthisis, never shew a symptom after their arrival.† There can be little doubt that the beneficial effects of elevation are in a great measure attributable to the habitual increased expansion of the chest.

* The American Quarterly Journal. July, 1852.

† Edinburgh Medical and Surgical Journal.

II.—THE DIET.

The consideration next in importance to the air respired, is the diet upon which a tuberculous subject ought to subsist; we shall have to consider this in reference to infants, children and adults.

The diet of tuberculous infants.—The appropriate rules under this head may be briefly laid down. The child of a tuberculous mother ought never to be nursed by its mother. The child of a tuberculous father ought to be nursed by the mother, if she be healthy and vigourous, but if she be anæmic or chlorotic, or affected with any hereditary disease, as cancer or gout, or weakly from any cause; or if, without any obvious cause, her milk be insufficient, or defective in nutritious principles, the child ought not to be nursed by her; and since the mother desirous of nursing her offspring will frequently do so, pertinaciously and regardless of any consideration respecting herself, it ought to be explained that this rule is imperatively demanded for the *interests of her child.* The attempt to bring up the child of a tuberculous parent by hand ought never to be sanctioned.

In selecting a wet-nurse, the hygienic principles generally laid down by practical writers should be rigidly adhered to, and the same principles of rejection are applicable as in the case of the mother. There must be no marks of scrofula, nor any signs of a tuberculous constitution; there ought to be no symptom of any constitutional debility nor of any hereditary disease, and the breast should be well supplied with good milk. There ought to be no family disease whatever liable to be transmitted hereditarily. The wet-nurse should have been confined about the same period as the mother of the child. The utmost care should be taken of her health during the whole period of suckling; she should occupy a large, well ventilated bedroom; should take considerable exercise, and be much in the open air; should have good nourishment, void of excess; should be able to maintain her strength without the artificial aid of stimulants; should have sufficient but not too much sleep, and should rise and retire to rest at early and regular hours. Just in proportion as these conditions are fulfilled, will the chances be of eradicating the tuberculous habit in the infant when it occurs in the slighter degrees, and of improving the constitution when more intensely tuberculous.

For the first five or six months a tuberculous infant should have no other food than the breast milk, but after this period it most

frequently becomes necessary to add one or two light, liquid farinaceous meals; and occasionally some light animal broth. If a plan of diet of this kind is found to succeed, it may be continued until after the period of the first dentition; but, as a general rule, tuberculous infants require to be weaned after ten or twelve months' nursing, and if anything should go wrong with the wet-nurse, even before. Nursing protracted beyond this period is calculated to debilitate and give effect to the tuberculous transformation of the blood and of the nutritive blastema.

The diet of tuberculous children.—The real difficulty as respects diet arises after weaning. Since the principles of dietetics applicable here are precisely the same as in the adult, we must refer to the next head for some of the more important considerations. Suffice it to say, that our most watchful care is required to see that children are fed with a diet which contains all the staminal or essential principles of nutrition, in due proportion; that they are neither over, nor under, nor too seldom, nor too frequently fed; and that their diet is neither too concentrated nor too diluted. In practice, we find all these points most grievously sinned against. Animal food should be allowed from the very earliest period that they can masticate it; and they should be most carefully taught to do so. They ought also to be habituated to the use of fat, and should any difficulty on this point arise the meat should be so chopped and mixed with the fat as to disguise it. Neither the principle of invigorating the frame, nor the tendency to strumous dyspepsia, ought ever to be lost sight of; and the latter ought to guide us in the rejection of injurious and doubtful articles of diet. Of these, articles having the saccharine principle as a basis are, perhaps, most frequently at fault; an excess of sugar ought to be carefully guarded against; and when we consider the weak structure of the digestive apparatus and the defective animalization of the digestive fluids, it becomes obvious how necessary it is to prohibit fermentable, and tough, indigestible vegetable matters, as jams, marmalades, fruits with thick skins, "waxy" potatoes, and the like. As children advance in years, their diet admits of modification, but so long as the object in view is to renovate the tuberculous constitution, and no local disease exists already inflaming the blood, a good diet should be steadily maintained. Even throughout various forms of local inflammatory disease such a diet is attended with the most beneficial results over the local mani-

festation, as frequently witnessed in tuberculous ophthalmia, cutaneous affections, bronchitis, affections of bones, glands, &c. It has sometimes happened, at all events in adults, that in consequence of a good diet, in conjunction with constant exposure to the open air and exercise, the tuberculous state of the blood has given place to healthy hæmatosis and the local disease has healed, even in the last stage of tuberculosis pulmonalis.

At a comparatively early age, strengthening beverages, such as porter and bitter beer, may be cautiously allowed to tuberculous subjects. These stimuli are often borne far better by such subjects than by the healthy. The object should be to mix them with the food at meals with a view to promote its digestion, and to contribute to its nutritious qualities. But I believe that the minute portion of alcohol these fluids contain has an ulterior operation. That, received into the liquor sanguinis, and even carried into the blastema of the tissues, it acts as a stimulus to the metamorphosis of the more essential principles of nutrition, promoting cell growth and assimilation. At the same time, the effect of alcohol on young subjects, even though tuberculous, and when prescribed as a remedial agent, ought to be watched, we have to be careful not to produce over action and consequent exhaustion, either in the molecular action of the blood or in the action of the circulatory and respiratory system.

The diet of tuberculous adults.—Most of our observations on diet apply to all ages, and the question is not only important as respects individuals who may be sick, but the habitual diet of tuberculous families, ought to be submitted to medical opinion and direction.

The first great point as respects diet, scientifically considered, is that the food of tuberculous subjects should contain a due proportion of the staminal principles. These should be of good quality; and the quantity of food, as a whole, should be sufficient but not excessive. The staminal principles to which I here more particularly refer are, the proteiniform, the oleaginous, the saccharine, and the aqueous elements of food, as defined by Dr. Prout. When we find delicate subjects insidiously passing into a tuberculous condition, or tuberculosis gradually progressing, indigestion, as pointed out in several parts of this treatise, is a frequent concomitant; but whether so or not, on strict enquiry, we most frequently find that the laws of health are violated as respects the component parts of the food. It will at once be obvious, that the remark does

not refer to that hackneyed enquiry whether this or that particular article employed as food is "wholesome" or not, but to the amount, and the relative proportions, of the constituents of the food actually taken *per diem, per mensem,* and *per annum.* Feed even a healthy infant with some fanciful diet consisting almost wholly of starch, and in about six weeks, starvation stares you in the face; not because such diet is unwholesome; nor because a sufficient bulk of food is not taken; but because it is deficient in the staminal principles. Add to this diet a fair proportion of proteiniform and oleaginous matter, and if the powers of life have not been too much depressed, healthy nutrition rapidly commences, and the emaciated infant recovers health and strength. This illustration is taken from the state of health, but errors of this kind in tuberculous subjects are fraught with even more disastrous consequences. It is by no means perfectly clear that the first link in the chain of causation is not frequently derived from this source; and under all circumstances, where tuberculosis exists, the most judicious attention to every other hygienic and therapeutic principle may fail wholly from a faulty diet; whereas, a truly good system of diet, steadily maintained, will enable the tuberculous subject to resist the operation of other etiological influences, and will contribute greatly to the restoration of the physiological state of the blood.

There can be no doubt of the necessity for a due proportion of those principles in the food having azote, and especially protein, for their base, but we are totally unacquainted with the relative advantages of its different forms and compounds. Some have recommended the stronger kinds of meat containing fibrin exclusively; others adhere to a more albuminous diet, and particularly new-laid eggs; others have seen much benefit from the flesh of cold-blooded animals, as of the turtle, and there is much evidence extant on the value of a diet derived from this department of the zoological scale. It would be most unphilosophical to attempt to fix a rule for patients indiscriminately, even as respects the staminal principles of food. Everything must depend upon their age, the state of their appetite and powers of digestion, and their capability of bodily exercise. In the treatment of this disease in its uncomplicated state, the best diet, that is to say, the diet containing the greatest quantity of the more essential principles of nutrition, that the patient can digest, is undoubtedly indicated.

Under this head our attention is called especially to the oily

principle, and the necessity there is of taking care, at all ages, that the diet contains a due proportion. Previous to the late discovery of the use of the cod-liver oil, many scattered facts were recorded which bear upon this point. Beddoes, Withering, Dr. R. Pearson, M. Creaser of Bath, and others, ascertained that all the forms of scrofula and phthisis are remarkably rare among butchers; and they attributed this circumstance, mainly, to butchers living chiefly on animal food with *fat*. They ascertained that the exemption corresponded with having lived well, and eaten hot fat meat for breakfast; and that they became liable to obesity, hepatic obstruction, and apoplexy, but very rarely to tuberculous affections.* A similar observation has been made at Montpellier and other places.

Butchers, however, do not enjoy any special immunity from this disease, since we find them in the records of the Consumption Hospital, and the exemptions above mentioned, although no doubt in part attributable to the cause assigned, may be referred also in part to other causes, as to the nature of their occupation, which leads them more into the open air and renders them less sedentary. But attention to this principle of dietetics from the earliest infancy is of paramount importance. The breast milk is often deficient in the oily principle. Asses milk often fails on this account. Tuberculous subjects will be frequently found to have fallen into the habit of rejecting fat from their diet, and there is considerable difficulty and some judgment required, in bringing them back to its use. In instances where the diet of tuberculous subjects has been found to be deficient in this principle, I have derived great advantage by substituting chocolate as a nutritive beverage, instead of tea. In young subjects affected with tuberculous marasmus I have also used, with advantage, as recommended by Dr. Paris and others, milk, impregnated with the fatty element of mutton suet, by enclosing suet in a muslin bag and then simmering.

It has been suggested by Lehmann, that a small quantity of fat in the alimentary canal is essential to the digestive processes; and that flesh and albuminous matters deprived of their fat are less digestible, although an excess of this principle exerts an injurious action. He very correctly remarks, that the oily principle is absorbed by the lacteals, and influences the metamorphoses of the albuminous constituents of the blood; exercising also a very impor-

* Southey on Consumption, p. 59.

tant part in cell growth, being present in the cell during its development, and the nuclei probably consisting of it. This subject has already been considered in reference to the essential nature of the disease, and will again be adverted to when treating of the use of cod liver oil.

We are not at present aware of the true relations which the staminal principles of nutrition bear to each other; but of late years, the introduction of a larger portion of the fatty principle into the economy, by the digestive organs, has been held to be beneficial in tuberculous diseases; and it has even been taught that the true antagonism of tuberculosis is to be found in the fatty condition of the body.

Milk diet.—No system of diet has been so highly and so generally extolled as a milk diet. An *exclusively* milk diet has been frequently recommended. Undoubtedly milk contains all the alimentary principles, but they are in proportions and combinations suited to the animal system in infancy. I have never yet met with any evidence which satisfied my mind of the advantages of milk as a general anti-tuberculous fluid, and I must refer to the chapter on etiology for some of the principal objections that appertain to its use. If patients beyond the age of infancy are sustained exclusively on milk, they very soon tire of it. The circumstance that it assimilates very closely in its nature to blood is by no means in its favor. The great desideratum is that the system should *make blood,* and that *all* the processes of hæmatosis should be completely performed, from digestion in the first passages, to depuration in the kidneys and liver; and no advantage is obtained by the introduction of a fluid into the stomach which is, to a great extent, prepared for sanguification. I offer no objection to milk forming a part of the diet of the tuberculous, but I am convinced, from close observation, that it should form only a small part, and should never be mainly relied on. Great attention should also be paid to the quality of the milk. I believe that the milk of tuberculous cows administered to tuberculous subjects, may produce a deposition of tubercle, even where no tubercle previously existed; and the frequency of this disease in cows is a notorious fact. I have seen an infant deprived of its mother's milk because she was of a tuberculous habit, and fed upon the milk of a cow which died of consumption. This child died with tubercles in almost all the internal organs, and the fact, in connection with

others of an analogous nature, made so strong an impression on my mind, that I have ever since been suspicious of milk as forming any considerable portion of the diet of consumptive people.

There is another consideration in reference to the use of milk in the diet of the tuberculous. When we mention milk—skim milk is generally understood, that is to say, milk deprived of the greater and more nutritive portion, of its oily principle. It will be found that many of those who have obtained the best results from the use of milk, have ordered *milk from the cow*; and have had it taken before the cream had time to rise, or the finer halitus even to disperse itself. This is a very different thing indeed from milk that has cooled and is skimmed. All the salts remain in the skim milk with the greater part of the caseine; it is probable that the salts enter into new combinations, and that the solubility and digestibility of the casein is modified. Hence I hold that if we are to depend at all upon milk for the purpose of renovating tuberculous blood, and improving the cell nutrition of tuberculous subjects, whether it be for children or adults, it should be as nearly as possible in its natural state. Goats' milk taken from the teat by young infants, I believe from observation, to be an adequate diet, and a useful remedy. For adults, a glass of asses' or cows' milk before rising in the morning, and repeated once or twice daily, is also beneficial, and to the morning allowance for some subjects, a dessert spoonful of rum may be added with advantage; but the chances of recovery must be very small indeed when this constitutes our main reliance as respects diet.

Goats' whey.—It has been said that the use of goats' whey of particular localities, in large quantities, two or three quarts in a morning, has cured consumption. The distinctive qualities of this kind of whey must depend upon its impregnation with the aroma and active principles of herbs. Accordingly the whey produced by goats which feed on high dry mountains, as those of Wales, Ireland, and some of the Swiss Alps, has obtained the highest degree of celebrity. Regarding tuberculosis as a disease of low vitality, especially seated in the blood, we can understand the rationale of such a remedy as this. The gentle and healthful stimulus of vegetable matter thus introduced with the elements of the liquor sanguinis, into the circulatory current, must tend to promote the nutritive actions of the blood, the formation of the corpuscles, the perfect structure and texture of the fibrin—in fact, to increase the

vitality of the blood; and if the tuberculous transformation has set in, goats' whey, like iodine and other stimuli, must tend to counteract it. It is easy to understand that such a stimulus, from its moderate and uniform action, throughout the mass of the blood, might be attended by much better effects than some of our most potent remedies.

In the course of my practice I have been led by circumstances occasionally to have infants fed during the ordinary period of suckling, upon goat's milk, and I must say, that they have always thriven well. In a family, undoubtedly tuberculous, where some of the children have presented tuberculous disease of the external glands, the mother being compelled to relinquish nursing, and having an insuperable objection to a wet-nurse, an infant, three months old, in a very advanced stage of marasmus, completely recovered on goats' milk; it had nothing but the breast milk of one and the same goat, for five months, and is now a perfectly healthy child. Goats' milk contains as great, and often a greater, proportion of the oily principle, and asses' milk a very decidedly smaller proportion, than woman's milk.

Attention to the facts recorded in the chapter on etiology, and an adherence to the understood principles of dietetics, will guide us in the details as to the diet in each particular case. I am practically convinced that, habitual excessive dilution is very injurious in tuberculous habits. I believe it assists to diminish the vitality of the blood, and the number of the red corpuscles, to render the liquor sanguinis and blastema less nutritive, and to deteriorate the cells and weaken the fibres. This habit should accordingly be corrected from the very commencement of our treatment. We must be careful also, in our attention to the more obvious staminal principles, not to run the risk of adopting a diet in which others that have not been mentioned are deficient; and on this account, to a certain extent, a mixed diet is necessary. With respect to the use of alcoholic beverages, I must refer to the facts already stated (p. 456). Entertaining the strongest opinion of their general injurious influence on the human constitution, I am not satisfied, but that the moderate use of those which contain some nutriment, or a bitter principle, with a very small per centage of alcohol, as porter and the light bitter ales, is attended with advantage. At all events, I have seen tuberculous families, by whom, from a very early age, such beverages have been habitually used, with good

food and attention to hygiene generally, who have grown up healthy; and among whom, when tuberculous affections have occurred in a scrofulous form, they have run a comparatively mild course, and have terminated favorably. The result of such beverages taken daily is, probably, that a greatly diluted stimulus is habitually contained in the blood, and permeates the blastema, exciting the nutritive actions, and promoting fibrillation and cell growth. At the same time, alcoholic fluids taken to the extent of exciting the nervous powers, and materially or even sensibly increasing the action of the heart and arteries, must, in weakly subjects, and particularly in children, by producing undue action, where there is a deficiency of power, according to the dynamic, as well as the chemical laws, result in increased debility, and an aggravation of the disease. So that upon this point, as in many others, no arbitrary rule can be laid down, but we must be guided by the constitutional powers of the individual, and the effects produced.

B.

The measures calculated to promote the elaboration of the materials of nutrition and the formation of healthy blood in the tuberculous constitution, involve considerations of the highest importance. Under this head we have to consider the circumstances, most essential in tuberculous subjects, to promote and regulate the true function of respiration, the digestion of food, the secretions, and the excretions.

I.—TEMPERATURE.

A definite temperature is necessary to sustain the essential vital molecular actions in the blood, and the whole of the above mentioned processes; and provision is made in the perfect physiological state of the organism to maintain that temperature. In cold climates and seasons, when the solar influence is slight and the radiation of animal heat great, the vital process is assisted by external measures to promote warmth, as by clothing and artificial heat in our apartments; but I consider, that in this climate, the assistance given is very partial and inefficient, and guided popularly by erroneous principles.

It has been shewn, that in tuberculosis the vital powers of the blood are low, and the molecular actions limited, and accordingly, the heat producing power is deficient. In tuberculous subjects,

therefore, as in the young, when the atmosphere is cold, greater artificial assistance becomes necessary to sustain the natural temperature. Less heat is developed from within, and the body, when placed in a medium below the temperature of 98°, requires more external aid to sustain its temperature.

The difficulty which tuberculous blood has in sustaining the heat of the body is shewn by the tendency to variations of temperature. At those periods of the day, for instance, when the different stimuli are received into the blood as food, &c. and the eremacausis of the materials is proceeding vigorously, the temperature of 98° may be sustained; but in the absence of these stimuli, and at other periods of the twenty-four hours, and under the influence of external cold, it has a tendency to fall below the physiological standard. Even when eremacausis, sanguification, and nutrition are most active, the development of caloric is barely sufficient to maintain the requisite temperature.

From these considerations it may be deduced that in tuberculosis, either in its minor shades as a predisposition, or when more confirmed, the external surface should never be allowed to cool excessively, and most especially that it ought never to be allowed to remain exposed to a low temperature, so as to produce upon it the *continuous* effect of cold.

The physiological principles of animal temperature ought never to be lost sight of in the treatment of this disease; and above all, that the subjects of it resemble the young of the class mammalia, generally, in having a low power of producing heat. The result is, that the function of respiration is more under the influence of external temperature than in health. External cold, in such subjects, has a greater effect in increasing for a time the rapidity and volume of the respiratory movements, which increased action tends to exhaust the vital powers, and owing to the low vitality of the blood in tuberculosis and the small proportion of red corpuscles, an approach to exhaustion more quickly takes place; so that notwithstanding the increase of the respiration, the effects of the cold are apt to be only partially counteracted, and the temperature of the body falls; this occurs especially if at rest; and when the temperature is sustained by severe exercise, the exhaustion of fatigue is apt to cause it to sink more rapidly and still lower.

The effect of cold on the surface of the body is to produce contraction of the capillaries, to diminish the quantity of blood circu-

lating in them, to arrest the cutaneous secretions and to excite the cutaneous nerves; the result is that the blood is thrown upon the internal organs, and particularly upon the lesser circulation in the lungs, the physiological effect of which is to increase the voluntary and involuntary muscular powers, and accordingly the functions of respiration and circulation.

The *vis physiologica naturæ*, in these phenomena, is beautifully illustrated by the reaction which follows in healthy subjects, where there are a sufficient number of red corpuscles and sufficient vital power. But in the tuberculous constitution, where this is not the case, and where the excitability of the nervous system is intact, or even more acute than natural, reaction is imperfect, and exhaustion more likely to occur. In some of the worst cases, where the nervous system is involved in the malnutrition, and its powers are depressed, the favorable results of this excitability and reaction are still less manifest, the power of increasing the internal evolution of heat is less, and the injurious effects of cold more decided.

The susceptibility to the agency of external cold and diminished power in the vital process of producing heat, if not duly appreciated and counteracted, has a most injurious tendency; and the immense importance of sustaining the animal temperature soon becomes evident. In tuberculous infants and children it is doubly important, by reason of their *infancy* and the tuberculous condition of their blood.

It is not the effect of cold applied suddenly or for a short period only that we have to consider, but the effect of its *continuous* operation. There are very few persons, even among the tuberculous, who cannot bear the shock of cold for a limited period, particularly if the body be previously heated. But where the power of producing heat is low, the body soon becomes cooled below the natural standard, and then it is, that the injurious effects of cold are experienced; these effects, in children and old people, are cumulative, and often not made immediately sensible or apparent; and this is the case also in tuberculous subjects.

This indication divides itself into two parts:—

I. *To sustain the temperature of the blood within doors, and during sedentary occupations.*—I consider this part of the treatment of tuberculosis most inefficiently attended to in general. The object should be to sustain the temperature of the body at a

uniform standard within doors and during sedentary occupations, and it is to be effected by regulating the temperature of the atmosphere and by clothing.

In our autumns, winters and springs, to sustain the heat-producing power of a tuberculous subject, and the temperature of the whole body at 98°, the air of the house should be kept at a nearly uniform temperature of from 55° to 65°, varying somewhat according to the external temperature. Every room in the house should be kept, day and night, at this degree; a circumstance rarely if ever attended to. In one of our ordinary private houses, where there were several cases of tuberculosis, and one of tuberculosis pulmonalis, I have found the temperature of the bed-room in a winter morning 34° to 35°, that of the stair-cases and passages 33°, that of the breakfast-room ranging from 40° to 80°, being at 40° near the doors and windows, and 80° near the fire-places. The sitting rooms in the morning have been 45°, and in the evening 75°. This variability of temperature is most injurious to tuberculous constitutions. A delicate female getting out of bed in the morning, after the animal temperature has been sustained for many hours, first meets with the shock consequent upon plunging into an atmosphere at nearly the freezing point; she then occupies herself from half to three-quarters of an hour or more at her toilet table, and gets thoroughly chilled; in passing already chilled through the passages and corridors down stairs, she meets with a blast of cold air, she then takes her seat close to the fire within a range of intense radiation, the front of her body is subject to a temperature of 140° or 160°. A draught of air plays upon her back at 40°,—on one side her limbs are subject to air at 40°, and on the other side at 60°, for notwithstanding the laws of equilibrium it may be shewn experimentally that all these differences of temperature frequently exist in the same apartment. Under these circumstances, not only are parts of the body, as the limbs, chilled, and a general sensation of chill or cold produced, but the heat-producing power is still further depressed, and the individual thereby rendered less competent to resist the agency of cold throughout the day, particularly in the external air.

The popular objection to properly warmed rooms, viz. that "they increase the danger of taking cold," is founded upon the most erroneous principles, or rather, neither upon reasoning nor experience. In the coldest climates, as of Russia and Lapland,

the rooms are far better heated than in England; the huts of the peasantry are said to resemble ovens rather than rooms; yet the inhabitants leave their rooms and respire an atmosphere below zero with impunity; and colds are less frequent than with us. Even persons in health experience less inconvenience from exposure to external cold after being in a warm room, with their bodies and limbs of a uniform natural temperature, than they do when they pass into the cold air already in a state of chill; and exposure to cold is still less injurious when the temperature of the body is above the natural standard. Dr. Southey remarks: "Let two men set out on a mail coach on a cold night, the one well warmed when he takes his seat, the other shivering from cold, and at the end of the journey of fifty miles, the man who started warm will hardly have felt cold, and the other will never have been warm."*—In tuberculosis, in proportion to the low power of producing heat, the injurious effects of cold when the body is already chilled present themselves in an aggravated form.

If therefore tuberculous subjects are to have the best chance of recovery, the indoor temperature must be sustained at a uniform standard, and that in the climate of Great Britain, during the inclement season of the year, ought to be from 55° to 60° Fahr.

Let no one be deluded with the false notion, that living in draughty houses of unequal temperature is conducive to health—that it renders the body hardy, or less susceptible of the morbid influence of damp and cold out of doors. It is a physiological impossibility, and the converse is the truth. The heat-producing power of the animal economy is sustained, *cæteris paribus*, by a certain degree of external warmth, and depressed by cold in proportion to its degree and continuance. It is true that a provision is made for the regulation of animal heat, and that reaction is produced by the impression of cold; but the operation of this law depends upon the exercise and food, the integrity of the health, and the perfection of the pulmonary apparatus; and even in health, its continued operation, to meet incessant vicissitudes, is not to be depended upon. Where the heat-producing power is radically defective, or below the standard of health, reaction becomes weak, with difficulty sustained, or impossible. The inhabitants of cold climates, well fed chiefly with animal food, by warm clothing and warm habitations are enabled to expose themselves to, and bear with impunity, an

* Observations on Pulmonary Consumption.

intensely cold atmosphere every day, and as already urged are less liable to colds, coughs and consumption than the English.

In recommending, in the treatment of the tuberculous, that their habitations should be better warmed, the principle of ventilation and a sufficient renewal of air must not be overlooked. I believe the primary desideratum is, that the temperature of the air that feeds the apartment should be raised to the requisite standard. For this purpose it is not necessary to dispense with the fire and open fire-place. A well constructed stove to warm the well of the staircase and the passages is sufficient. If, in the winter season, the air in this part of the house is kept at from about 55° to 60°, there will be all the cheerfulness arising from, but *less dependence upon, the open fire,* the evil of draught will be reduced to a minimum, the tuberculous subject may move about throughout the house and may sit and read, work, or take meals, in any part of the room, without any necessity to go within the sphere of intense radiation from the fire. The especial precautions required in the supply and expenditure of the warm air of the passages are, that it should be regular and continuous, derived from without, and pure, not too dry, and that it is neither stagnant nor supplied in forcible currents; for draughts or currents of hot dry air are as injurious as those of cold air, and sometimes, from their deceptive character, more so. The tuberculous inmates of a house, the temperature of which is thus regulated—infants, children and adults—will, for the most part, with proper attention to clothing, be able to take exercise in the open air, more or less, in almost all weathers, and the advantages of returning to a warm house in cold weather will not be found less than those of being comfortably warm on going into the cold.

II. *To sustain the animal temperature out of doors.*—If it be essential in tuberculosis, to sustain the animal temperature within doors by artificial assistance, it is at least equally so in the colder atmosphere out of doors.

From that which has already been stated, it follows, that tuberculous subjects should never expose themselves to the external cold except when the body is warm. When they are about to do so, and the body is wholly or partially chilled, they should previously resort to artificial heat; and it is always safer to raise the temperature above the natural standard, than to allow it to remain below. This rule is in no case of more frequent practical importance than

in the treatment of young delicate children. It ought to be laid down as a rule to nurses, never to be deviated from, that before they take children into the open air in cold weather, they should be careful that their limbs are thoroughly warmed.

Dr. Southey states, "in all those cases in which I have recommended confinement in rooms heated to 60° or 65°, I have remarked that the attendants most employed in those rooms were less subject to catarrhs than the rest of the family."

The dryness or moisture of the atmosphere is a very important consideration in connection with the temperature, and the habits of out-door exercise, in cold weather, by tuberculous subjects. For the most part they are prohibited crossing the threshold of their habitations when the weather is cold, damp, showery, wet, or threatening to be wet; and they very soon engender the habit of regarding the slightest inclemency of the weather; and accordingly, of remaining within doors for weeks and months together. I am quite certain, not only that this seclusion is carried much too far, but that it has a most injurious tendency. With a perfectly adequate notion of the injurious effects of cold and damp, with sedentary occupations, I still think too much importance is attached to the moisture of the atmosphere in reference to out of door exercise in this climate, particularly by females and children. Our November fogs, for instance, increase the conducting power of the air, and render it thereby relatively colder, although radiation is diminished, and the precautions to be taken against cold are thereby rendered more necessary; but it has been shewn, that the moisture of the air is not directly associated either with the essential cause of the disease or its frequency.

When tuberculous subjects expose themselves to rain or a cold atmosphere, surcharged with moisture, they require to be more cautious not to leave the house chilled, and also not to take exercise sufficient to heat themselves unduly. It is in this latter that the danger lies. Just enough exercise should be taken to keep the body comfortably warm, and not sufficient to hurry the circulation and excite perspiration. So sure as this is done, the cooling process commences, and with it the risk of the injurious effects of the body being partially or generally chilled; and in tuberculous subjects these effects consist especially in colds, coughs, glandular affections, and the like. Patients should be especially cautioned when caught in a shower of rain, by no means to run so as

to get heated, but to walk at a pace sufficient to keep the body and all its parts at a *safe temperature*. When they reach home their immunity from the injurious effect of cold and damp depends very much upon the temperature of the house. Damp or wet clothes should be changed, and if a subject, however delicate, has been even soaking wet through, but at the same time has avoided over heating, and change his wet clothes in a warm room, it is impossible that the wetting can do any harm. The mischief always arises from the cooling process, and the chances of its arising are proportionate to the previous heat of the body and the low temperature to which it is subsequently submitted. A healthy woman heating herself in a shower of rain, changing her clothes in a cold bed-room, and then sitting in a draught, is nearly certain to incur some one or other of the morbid effects of cold; whereas, a delicate woman, getting soaking wet through, but being careful not to allow the body to be either heated or chilled, and returning to a habitation in which all the rooms are kept at a uniform and appropriate temperature, may do so a thousand times without any injurious consequences.

The greatest caution is necessary when the body is in a perspiring state, as respects change of temperature. Perspiration is a cooling process, but by no means so much so as vaporization or transpiration. It most frequently results from the blood having been unduly heated and its circulation hurried. Drinking while the body is warm, the atmosphere being at the same time warm and loaded with vapour, will often produce it suddenly, even in health, but especially in the tuberculous. In tuberculous subjects with a very low heat producing power, in this manner what is called "clamminess," is very readily brought on. That is to say, the temperature of the blood is rapidly raised, and perspiration is rapidly produced; but owing to the instability of the powers of sustaining the heat, the temperature of the external parts falls the moment increased transpiration begins, and the surface, or certain parts of it, becomes cool and moist, or "clammy." The surface should never be subjected to the influence of a colder atmosphere during the continuance of this state. It is then that the impression of cold becomes injurious, when the whole body or any of its parts is more or less rapidly cooling, and when exercise has ceased to sustain the circulation and the normal production of animal heat. Colds, coughs, congestions and inflammations are with the greatest

facility produced, by draughts of cold air and exposure to cold under such circumstances, but the popular notion that these illnesses result from exposure to cold while the body is heated, is an error; they result from exposure to cold while the heated body is cooling by the processes of transpiration and perspiration, and the chances of injurious consequences are in proportion to the rapidity and extent of the cooling process, and the degree and continuance of the cold.

Clothing.—The clothing of tuberculous subjects requires very careful management. The notion that to render people "hardy" they must go half naked, is another frequent popular error. The material and the quantity of clothing require consideration, and they should be regulated by the change of season and the change of weather, and not by the fashion. Tuberculous subjects will do well also to adapt their clothing to different periods of the day, and where they live in cold and draughty houses, even for the different apartments they occupy. In one account of the Russians before me, it is remarked, that they go very warmly clad out of doors, nothing being left open to the action of the air but the face and neck, "although they wear nothing but a shirt and a pair of linen drawers within." (Phil. Trans., vol. lxviii, p. 625.) The principle of clothing in cold weather is to insulate the system and preserve its natural temperature, and in warm weather to allow of free continuous transpiration without exciting perspiration. Perspiration, owing to the evaporation which attends it, at the temperature of the body, is a cooling process, but it is far less cooling to the blood than vaporization and transpiration. To promote perspiration for the purpose of keeping the body cool, when subject to undue heat, is a great mistake; except so far as it corresponds with vaporization, it is a heating process, and such correspondence is by no means constant; the cooling process is not so uniform nor so efficient when perspiration is forced by excessive clothing, continued drinking, exercise, or stimulus, as it is with a soft skin without perspiration. The body will bear exposure to a very high temperature indeed when dry, but if moistened it can no longer sustain it.

When then it is impracticable to sustain the necessary uniformity in the temperature of the house, tuberculous subjects ought to supply the deficiency of external warmth by clothing. Here again there is a very common popular error in the belief that

warm clothing renders the body more obnoxious to cold. The same reasoning and similar facts drawn from experience are sufficient to refute this error. The seal-skin dresses of the Esquimaux are warmer than half a dozen of our great coats, and they enable the wearer to resist the lowest temperature; nor do the furs used by the Russians render them more subject to colds, coughs, or consumption. The clothing worn in-doors by invalids, male and female, in this climate, considering the imperfections of our dwellings as respects temperature, is in my opinion generally inadequate; and I consider that the custom ought to be prescribed, for tuberculous subjects, of employing extra in-door clothing in moving from heated rooms to cold passages, bed-rooms, and water-closets.

For tuberculous subjects then, apart from the considerations that relate to local disease, as a remedial measure, I would recommend, that, keeping themselves thoroughly warm within doors and during sedentary employments, they brave the external atmosphere of this climate fully. That they expose themselves to it during rain, hail, fog, snow, cold, heat and wind. Not without due precautions, the physiological principles of which have already been stated. They should never go out without being comfortably warm at starting; they should never remain out if they become cold or chilly and cannot sustain that degree of warmth; hence exercise and clothing must be duly adjusted. They should never unduly heat themselves, particularly to excite perspiration, when the atmosphere is damp or cold. Even infants should be habituated to the external air at all seasons from an early age. The effects of this exposure, with all the necessary precautions, ought to be watched. If properly regulated, it will in most instances produce increased energy of body and cheerfulness of mind, with all the signs of healthy reaction; and although this should occur only in a slight degree, it cannot be too much encouraged. If it produce depression of the vital energies, torpor, and a tendency to sleep, it is injurious; but in this case, it is necessary to discriminate whether the result be the effect of the exposure or of the exercise taken to sustain the temperature. It would be futile to expect benefit from exercise in the open air, when exertions are demanded beyond the available strength, to sustain the warmth of the system. A tuberculous subject then should be instructed at all times during cold weather, whether for one kind of exercise or

another, to leave the house thoroughly warm and well clad, to quicken his movements for a short distance, or until he finds by his sensations that the warmth of his body is fully sustained, so as to enable him to slacken them; and he may then, often, be exposed for a long time without fatigue, and without incurring any of the injurious effects of a low temperature.

When tuberculous subjects exhibit such a degree of debility, or are affected with local diseases, so that the principle of daily exposure to the open air cannot be carried out systematically in one locality, then arises the question of change of locality, the necessity for a residence in a protected or a warmer situation, and all those considerations which relate to change of climate and change of air.

III. *To avoid exposure to a very high temperature.*—A high temperature is often even more injurious to tuberculous subjects than exposure to cold. Applied continuously it has a depressing influence on the nervous energy, and causes languor and lassitude with disinclination both to bodily and mental exertion. It often happens that tuberculous subjects, who are so sensible to extreme cold, are also most acutely sensible to the "oppression" of external heat. This arises from two circumstances, the acute sensibility of the nervous system and the want of adjustment between the respiratory functions and the external temperature. When the external temperature is high, in a physiological state, the true function of respiration diminishes; and so in tuberculosis, the function of respiration is lower than in health, but it is not sufficiently low to compensate for the effect of the continued operation of external heat; nor has it the power of adjustment as in health. On the contrary, external heat frequently increases the respiration in tuberculous subjects, and then there is not only the external heat but the internal production of heat to produce the oppression. The antagonism to this is found in the insensible, vaporous transpiration and the perspiration; but these are often partial in their operation and imperfect in their results; and when they are more complete and efficient, the surface is often cooled below the natural standard, sometimes very suddenly, and becomes "clammy." These latter effects are promoted by the exhaustion produced by the augmented temperature; and are the direct consequences of the low power of sustaining the natural standard of heat, as the body or any of its parts rapidly cools.

These considerations explain the frequent injurious effects of hot climates upon tuberculous subjects; the relief afforded by migration from the sultry shore or valley to the mountain plain; and the apparently contradictory sensations complained of by tuberculous subjects, under different circumstances of heat and cold; and they are among those circumstances which render change of air or change of climate necessary in hot seasons and hot countries.

II.—EXERCISE.

On reference to the subject of deficiency of exercise, as a cause of the disease, (p. 462), and to that of the diminution of muscular power as a symptom (pp. 99, 109), the importance of exercise in the treatment is manifest. The best system of hygiene, in all other essential respects, and the most efficient therapeutical measures, will fail, if judicious instructions are not given, and carried out, for the regulation of the exercise to be taken by tuberculous subjects. This has been felt by practitioners of all ages, but none have attached more importance to it than Sydenham; who declared, that bark is not more effectual in curing agues than exercise is in curing consumption.

In favour of exercise as a remedy, we have the testimony of Galen, Stahl, Sydenham, Baglivi, Dolaeus, Lassalle, Desault, Pringle, Lieutaud, Fothergill, Salvadori, May, Rush, Bayle. (Young on Consumption.) Sir J. Clark, Lugol, Carmichael, and many of the most celebrated practitioners of modern times, have also written on its advantages. Dr. Rush, who combated the disease in his own person, is one of its most strenuous advocates; he regards horse exercise and long journies as a "radical cure."

Many of these celebrated men have recorded cures of the disease, in all its stages, which they have attributed to exercise alone, or to exercise in combination with other remedies; and particularly with good diet. I have before me a collection of cases, published by different practitioners at different times, as instances of recovery from tuberculosis pulmonalis; in a majority of which, exercise, and particularly horse exercise, was the prominent remedy. Yet, in this country, notwithstanding the general activity of the inhabitants, and the frequent use of horse exercise, upwards of one-sixth of the deaths at this time, are produced by tuberculous diseases.

In truth, there is but a very small proportion of the tuberculous cases for which exercise is prescribed as a remedy. It may be said, that its application in a majority of instances is impracticable. We will not stop to ascertain to what extent this may be true, but at all events, this principle of prophylaxis and cure ought to be a primary consideration in every plan of treatment.

Exercise in the treatment of tuberculosis may be either *active* or *passive; general* or *limited;* and includes *equestrian, pedestrian,* and *carriage* exercises. The whole subject, to be treated philosophically, would occupy a considerable volume; in this place we can only direct attention to the more essential considerations.

The primary object of exercise is to increase the strength of the individual; hence, in prescribing it, we are dealing with vital power. We have to consider, in the first place, the existing state of the vital power of the patient.

The indisposition to muscular exertion in a majority of tuberculous subjects, and to both mental and muscular exertion in others, has been described. The proceedings adopted to counteract this tendency require to be based upon the most judicious principles. We have to bear in mind, that we are dealing with a state of health in which there is direct debility, or a very inadequate development of vital force. At the same time there is morbid excitability, and accordingly, by injudicious proceedings, a great risk of exhausting the little power that exists. The effect of that exhaustion is, necessarily, to arrest all those processes upon which the system is dependent for the renewal of muscular power. Violent temporary exertions, under these circumstances, can but be most injurious, and it is in this way that occupations of life attended with such exertions prove injurious. They tend to a still smaller production of vital power and confirm the debility of the disease. Many an individual who might have lived for a long period, or recovered, has had the disease irretrievably precipitated by such exertions. At the same time, moderate, continuous exercise, which expends a portion of the available vital force without exhausting it, induces the natural reactions by which it is renewed. That is to say, it excites—the action of the heart and arteries—the nutritive processes in all the tissues —the demand for supply or the appetite—the digestive and respiratory functions—and the reciprocal actions of organizing molecules and the physical agents essential to life. Keeping these principles steadily in view, they may be made to operate as un-

erring guides in regulating the exercise of tuberculous subjects. It must not be overlooked, that in tuberculous subjects the heart is most frequently small and weak (p. 291), and that it is often especially so in relation to the voluntary muscles and muscular power; rendering it excitable and liable to palpitation and exhaustion.

The vital force should never be exhausted. The rule usually laid down, is "to encourage as much exercise as can be borne without fatigue." A better rule would be, to allow of as much exercise as the patient can bear without producing a greater degree of fatigue than will be entirely recovered from after moderate rest. This distinction may appear trivial, but the best test of the injurious or beneficial tendency of muscular exercise, is found in the state of the muscular and other manifestations of vital power after subsequent rest.

If a tuberculous subject retire at night fatigued, this is but natural, but if he rise also fatigued after a proper amount of sleep, either the exercise of the previous day has been excessive, or it has not been of a proper kind in relation to his state of debility and the slowness with which his system recruits its vital force. If the same amount of expenditure of force be kept up from day to day with the same results, the exercise he takes is increasing his debility; assimilation, and particularly cell-growth and nutrition, becomes less and less perfect, the destructive exceed the assimilative processes in the organic tissues, and atrophy sets in or progresses. Diminished nutrition is the result of this exhaustion; and thus, the labours of the day, which ought to sustain the vital force, absolutely destroy the very source of its supply.

The same kind of injury results from excessive muscular exertions of a more temporary nature by tuberculous subjects. A degree of exhaustion of vital force may be produced which will require a very long period to recruit itself, the effects of which, may, in fact, never be recovered from. It has occurred to me, several times, to trace the first indications of that debility and atrophy which precedes the deposit of tubercle in the lungs to an imprudent feat of walking, riding, or boat-racing. No violent exercise ought ever to be taken by tuberculous subjects during a state even approaching to exhaustion from fasting.

Besides the general object of increasing the vital force of the patient and thereby obviating and arresting the progressive debility,

exercise is prescribed for the more special purposes of exciting the action of the heart and arteries, augmenting the animal temperature, and increasing the function of the lungs, the power of the muscles of respiration, and the capacity of the chest; the latter is affected, more or less, by every species of *general* bodily exercise; and particularly by those exercises which produce a full, deep, rather slow, but sufficiently often repeated, inhalation. The important principle, insisted on by Woillez,* that the development of the chest is more directly influenced by the activity of the general muscular system, than by that of the thorax and the superior extremities, has a direct application here, and leads us to place less reliance upon certain unphilosophical mechanical contrivances for producing partial and forced exercise of the chest, than upon general muscular exercise. This latter tends to promote the circulation through the lungs and the interchanges between blood and air resident in the chest. It increases the functional activity of the lungs, the effect of which is a demand for space, and since the containing parts are adapted with precision to their contents, it must tend to increase the capacity of the chest. General muscular exercise is also especially advantageous to tuberculous subjects by promoting the circulation in the chylopoietic viscera, and the cutaneous functions. It also increases the development of animal heat; and its effects in influencing the temperature of the body have to be watched and regulated in relation to the tuberculous constitution.

The injurious effects of exhaustion being steadily borne in mind, and a careful investigation having been made of the capabilities of the patient, the next question is, the kind of exercise to be prescribed and the mode in which it is to be regulated. General exercise out of doors is always to be preferred, and the advantages of equestrian exercise are established upon the highest and most unequivocal testimony.

The peculiar merit of *equestrian* exercise is, that it calls a larger number of muscles simultaneously into action with less fatigue, and in a corresponding degree, with less risk of exhaustion; it promotes a free and consentaneous action of the whole of the circulatory, the respiratory and chylopoietic organs; and it implies a fuller respiration of pure air, and more complete renewal of the air resident in the chest. All who have considered the etiological facts

* Récherches sur l' inspection de la poitrine, p. 352.

recorded in this work will at once see, that in this instance theory and practical experience are in perfect unison.

But in the different grades of society there are comparatively few who can command equestrian, and accordingly our chief reliance must be on *pedestrian* exercise. The whole of the effects just now ascribed to horse exercise are produced by walking, but in a minor degree; the great drawback to the utility of the latter lies in the fatigue which it produces.

This fatigue in tuberculous subjects has to be most sedulously watched. Its diagnostic value has been described. Its importance is equally great as a guide to treatment. The amount of exercise a patient takes from day to day should be carefully estimated. In progressive cases, where no system of treatment is of avail, the muscular power fails gradually, and it never regains a point from which it has receded. In cases less necessarily progressive, and in simple cases of predisposition, much depends upon regulating exercise. As already stated, the powers of the system should never be fully expended. The effect must be estimated, not alone by the fatigue produced, but by the state of the patient after rest; and the patient should be taught to regulate the exercise of each day by the effect of that taken on the preceding day; for this purpose the *pedometer* is not only a useful but an amusing instrument.

Carriage exercise is to be preferred where the patient cannot bear the fatigue of walking or riding; it is always better than remaining in-doors all day, but it requires great attention to keep the body warm by means of clothing, and to avoid thorough draughts in close carriages. Whenever practicable it should be alternated with pedestrian exercise.

Under the head of *limited or partial exercises,* those which involve the action of the respiratory apparatus are of the most importance. In the first place, every obstacle to the natural movements of the chest ought to be removed. For this purpose the use of tight garments should be peremptorily discarded; and in particular the use of stays by young tuberculous females. Among the exercises of this partial character, *swinging* is highly extolled by Dr. Carmichael Smith, and some other authors; Autenreith, who is said to have been the first to recommend deep and frequent inspirations to improve a contracted chest, advised his patients to place their hands on a solid support, and exercise themselves by taking repeated deep inspirations. The *Scotch horse,* which is used in a

sitting posture, with the arms resting on a solid body, is certainly a better and more philosophical method of effecting the purpose. Sir J. Clark very strongly recommends the "*club exercise,*" which is employed in the army, as a preparation to the sword exercise; it calls into combined action the whole of the muscles of the arms and trunk; the Persians and Hindoos employ it to a very great extent, with the effect of producing a remarkable development of the muscles of the arms and trunk, and a corresponding increase of strength; (lib. cit., p. 299). I have been in the habit of recommending the "*chest expander,*" an elastic material with two handles, in the play of which the arms are kept in continual motion over the head and the chest fully expanded. To these may be added *fencing* and the *dumb bells,* for the purpose of exercising the arms and expanding the chest.

The object of all these partial exercises is, or ought to be, to give freedom to the circulation of the blood in the pulmonary vessels, to expand the lungs, especially at the upper lobes, and increase their elasticity, and to increase the capacity of the chest. Autenreith, who much insisted on them, remarks, that in early youth they increase the pliability of the upper ribs and augment their growth, and that, if systematically pursued, they alter the form of the narrow chest and the wing-like projection of the scapulæ to a proportionably broad round chest. Their more especial object is to counteract the functional inactivity of the organs and the malformation of the parietes of the chest, which operate as predisposing causes of disease of the lungs in tuberculous subjects.

The same object is attained by the physiological action of the chest in singing, reading aloud, and public speaking; and with care they may all be resorted to advantageously by tuberculous subjects; but as respects the whole of the methods of exercising the chest, precautions are imperatively required.

The Italian translator of Portal's work (lib. cit., p. 42), remarks, "I have observed young people, lean, delicate and predisposed to phthisis, who, by violent exercises, have acquired a new energy, and a *force of nutrition* very different from that which they possessed before. *Gymnastic exercises* have been looked upon as the best remedies for the cure of phthisis, by the most celebrated physicians." But these exercises require to be selected philosophically, and rather upon the general principle as pointed out by Woillez, than with more partial views.

Sir J. Clark very strongly condemns exercises which require excessive bodily exertion, as climbing precipices, &c., on the principle of their exciting an inordinate action of the heart, and rendering it liable to be oppressed by the blood suddenly forced upon it. (lib. cit. p. 303.) In partial exercises of the limbs, and of particular regions of the body, the utmost care must also be taken, to avoid the effects of pressure and injury of particular organs, by determination of blood, over distension of vessels, and congestion. M. Lombard found a greater number of artizans affected with phthisis, whose occupations required violent exertions of the superior extremities, than of others, whose employments did not require such exertions. In all exercises that determine the blood to the lungs, the first indications of *pain* or *constraint*, or of that *breathlessness*, which shows that the blood is with difficulty returned, should be attended to, and the exercise should be suspended or modified; hæmoptysis is the frequent result of inattention to these indications. Salvadori was at fault in this particular, and his system, in which he directed his patients to climb an eminence quickly till they were out of breath and bathed in sweat, was with justice condemned. The greater the freedom of the circulation through the lungs, the better the health, but any exercise which forces the blood in a greater quantity, in a given time, into the lungs, than, in the same time, can be returned by the pulmonary veins, is attended with a great risk of injurious consequences.

The exercise of young infants is as important as that of adults, but here it rests in a great measure with the nurse, who should never be allowed to neglect those nursing exercises so absolutely essential to the health. Every freedom should be given to the limbs of children, and the passive exercises of *friction* and *shampooing* are attended with the greatest advantages. For children as they get older "no innocent exercises should be foregone which are dictated by nature and by common sense." (Dr. Hull, l. c., p. 110.) The rocking-horse, the scotch-horse, battledore and shuttlecock, the usual athletic exercises for boys out of doors, and various gymnastic exercises, without and within, for both sexes. From all that has been stated, it is plain, that exercises conducted in the open air, are infinitely most efficient, but rather than allow tuberculous children, or even adults, to remain long sedentary within doors, or to want an object for bodily

exertion, many of the exercises mentioned, and others that may be devised, should be continually resorted to; and this applies to females as well as males, and to children at home as well as in schools. I have found the principle universally admitted, but on close investigation, it will be often found that, for remedial purposes, it is carried out inadequately.

Exercise is indicated in the treatment of tuberculosis at all ages, throughout all its stages, and in all its forms and varieties, so far as the disease of the blood is concerned. Unfortunately it is too often contraindicated by the existence of local affections which will not admit of its continuance. When a phthisical patient ceases to take exercise the case is too often hopeless, and it is undoubtedly correct in principle to delay confinement to the house, and particularly to the bed, as long as possible. Even in diseases of the limbs, this indication for the treatment of the general disease, ought not to be lost sight of. Its beneficial effects were some years ago well illustrated by M. Lugol, in his "Essay on the effects of Iodine in scrofulous disease." M. Lugol boldly deviated from the ordinary doctrines and the practice of the day, by allowing tuberculous patients afflicted with local disease in the various forms of scrofula, even those who had severe disease of the ankle, knee, or hip joint, to walk in the wards or open air during the whole plan of treatment. The general custom was, and still is, to restrict such patients to absolute confinement in bed. M. Lugol remarked, that rest is a debilitating agent, the ordinary associate of all antiphlogistic systems of treatment, that the most vigorous and robust constitution would be inevitably weakened and brought to a state of etiolation by long continued repose, and that it must necessarily aggravate the debility of this disease. There can be no doubt, that scrofulous patients, after confinement to bed for months, particularly in the wards of a hospital, not only become pale, weak and emaciated, but that an active tuberculous state of the blood sets in, and tubercle is deposited in the lungs, and frequently in many organs at once. At the same time, the treatment of patients under these circumstances is improved of late years. They are generally allowed a better diet, and the wards of hospitals are better ventilated than formerly; and I believe that the injurious consequences of hospital discipline are diminished. As respects diet, it is only necessary to turn to the facts relative to the production of tuberculosis in prisons (p. 488), to shew the influence of a good diet

alone, in counteracting the effects of other injurious influences. This is one of the cases, in which it often happens, that the indication for the treatment of the local disease (absolute rest), is diametrically opposed to the indication for the treatment of the constitutional disease (exercise); so that long confinement to a sick-bed can but be regarded as a "dreadful necessity." In this point of view, a demand is made on our best judgment to resort, in the treatment of the local disease, to every practicable expedient that will tend to prevent the necessity of confining the patient to bed; or if this cannot be avoided, to curtail and to ameliorate the evils which too frequently result from absolute rest in a more or less vitiated and confined atmosphere.

Choice of Occupation or Profession.—The injurious effects of sedentary employments in the tuberculous constitution, and the production of the disease under the combined influence of want of exercise and impure air, are sufficient to shew the very great importance to youth, of a proper selection of the profession or occupation to be followed for life. To place a young girl hereditarily predisposed to this disease, to the business of a sempstress in a large town, or a youth under similar circumstances, to sit daily in a close counting-house or office, or to a profession or trade admitting of but little exercise in the open air, is to make a complete sacrifice of the chances of continued existence. Van Swieten is quoted as stating, that he saved the lives of many artizans confined to sedentary occupations, by advising them to procure employment as coachmen. By timely and judicious advice on this point, to the parents of tuberculous families, much misery may be prevented. The etiological facts leave little doubt that a sedentary life is even more efficient than the respiration of a close and vitiated atmosphere in producing the disease; since, while the body is at rest, the air is comparatively stagnant within the chest (pp. 462, 496); and this is especially the case where the predisposition to tuberculosis pulmonalis exists.

III.—THE DIGESTIVE FUNCTIONS.

Sir J. Clark, and most of the practitioners of this country, attach the greatest importance to attention to the digestive functions, in every form and variety of the disease; and certainly, when we consider the all but constancy of the strumous dyspepsia of children, as preceding and attending scrofulous affections, and the

very great frequency of pain in the stomach, and other dyspeptic symptoms, in the early stages of tuberculosis pulmonalis in adults, associating these circumstances with the pathological anatomy of the alimentary canal (pp. 177, 189), there can be no doubt of its practical importance. Sir J. Clark points out very forcibly, that the error is not always in the kind of diet, but in the morbid condition, and the consequent derangement of function, of these organs; and acknowledging the great utility of tonic remedies, and especially of chalybeates, in the tuberculous cachexia, he shews that before these can prove beneficial, the irritation of the gastric system must be removed or greatly abated, and the functions of the whole chylopoietic viscera restored to a normal state (lib. cit., p. 311). To enter fully upon the treatment of strumous dyspepsia, in this place, would be only to anticipate the separate consideration of the various forms of tuberculosis, and the most important remark which suggests itself here is, that much may be done towards improving the secretions subservient to the process of digestion, and preventing, or abating, the morbid condition of the digestive function, by carrying out all the indications calculated to correct the tuberculous state of the blood, and especially those relating to air, diet and exercise.

The state of the digestive powers of tuberculous subjects should be very closely watched, with a view to the administration of such medicines as will correct the earliest effects of the debility which appertains to the disease. Of these effects the habitual retention of crude and imperfectly digested matter, and of morbid, and especially acid secretions, are among the most obvious. The tendency, in tuberculous constitutions, to excessive mucous secretions also frequently results, especially in young subjects, in a coating of the internal tissues of the intestinal canal with a more or less dense layer of morbid, tenacious mucus, forming a nidus for chemical reactions, and for the formation of acrid, soluble compounds, which are liable to be reabsorbed into the blood and deposited in the tissues, becoming the exciting causes of skin diseases, ophthalmia, and glandular and other affections; also irritating the mucous membrane, and producing congestion and chronic tuberculous inflammation of the mucous membrane, and impeding the regular absorption of the nutritive pabulum; in some instances, also, forming a nidus for the development of intestinal worms.

The earliest indications of these effects ought to be counteracted

by medicines, and, for the most part, very mild measures will be found to be adequate for the purpose. The usual routine of moderate doses of *Hydr. c. Creta* with *rhubarb,* more or less frequently repeated, according to the circumstances of the case, is often found to answer, particularly in infants and young subjects. At the same time, it so frequently happens that the practitioner is not called upon to prescribe before these symptoms have become habitual, nor until the function of the mucous lining of the alimentary canal, and its secretions, have become so thoroughly deranged, that more decided measures are necessary. Condemning, as I most candidly do, the frequent and unnecessary resort to large doses of *calomel,* and active purgatives, I consider the practice of temporizing with this condition of the alimentary canal is equally to be condemned; and although a full dose of calomel be an evil, it is a much smaller evil than the continued interruption to the healthy action of this important membrane. My own practice, therefore, has been, for many years past, under these circumstances, to commence the remedial process by the administration of one or two full doses of this medicine; which possesses more powers in evacuating, not merely the alimentary canal, but the glands and pores of its mucous membrane—of exciting the latter throughout its whole length and calibre, to cast off its coating of debris and tenaceous secretion—of allaying the subjacent chronic irritation, and of restoring the membrane to its physiological state—than any other medicine; and I feel satisfied, that by this practice, in the treatment of the scrofulous form, especially, of tuberculosis in children, much valuable time is saved, and that regimen or very mild medicine will subsequently effect all that is to be desired under this head.

The action of the liver has also to be carefully watched; but whether the alvine evacuations be clay colour, green or dark, I consider the treatment by mild alteratives, as above described, the dose being properly adjusted and judiciously repeated, adequate to correct them, and as affording a sufficient stimulus to the action of the liver. I have not found it desirable to prescribe full doses of calomel, or calomel in small doses frequently repeated, for the purpose of stimulating the liver; although when a dose or two is administered with the intention just now stated, the liver no doubt advantageously participates in the effect. These remarks apply strictly to the constitutional disease in its less developed, or what

may be called—more quiescent—state. When congestion of the brain threatens hydrocephalus, and other local diseases set in, new indications as respects this and all other remedies arise.

When tuberculosis sets in as an active disease, in infants, children, or adults, whether evidence be afforded of the deposit of tubercle or not, in the lungs or any other organ, purgatives should be very cautiously exhibited. The irritation of purgative medicines may produce a deposit of tubercle in the mucous membrane; or, if they already exist, it will lead to their softening and to ulcerative destruction. Uncontrollable diarrhœa has been produced by drastic purgatives in tuberculous subjects, without the slightest advantage, either to the constitutional disease or to its local manifestation in the lungs or elsewhere.

Alkalies.—The notion entertained by the chemical pathologists, that scrofula and tubercle depend upon an acid acrimony of the fluids, obtained, from an early period, a high reputation for alkalies in the treatment of the disease. In 1811, Mr. Brandish introduced a solution of caustic potassa, which was very generally employed as the most efficacious remedy for the scrofulous varieties of this disease, until the introduction of Iodine. The late Dr. Campbell, in his work published as recently as 1841, inculcates the use of caustic alkali in consumption as a solvent of tubercular matter, or its analogue, in the blood (lib. cit. p. 264). That beneficial results have been obtained from alkalies I think there can be no doubt, but it is very questionable whether they have ever done more than correct the superabundant acidity in the alimentary canal, which characterizes the debility of the digestive powers. Mr. Phillips, who, as well as Mr. Brandish, employed these medicines extensively, agrees with the latter, that in many instances it exercised a salutary influence; but he refers the effect to the general hygienic treatment which accompanied the use of the alkali, and not exclusively to the potash (lib. cit. p. 285). It has always appeared to me that better results are obtained from the use of Brandish's solution than from any other alkaline preparation.

IV.—THE CUTANEOUS FUNCTIONS.

The pathological condition of the skin in this disease may doubtless be corrected, to a certain extent, by ordinary ablutions and habits of sufficient bodily exercise, but when tuberculous subjects first resort to medical treatment, the morbid condition is

usually too urgent to trust to the slower process of depuration by these means; and even for the sake of improving the power and disposition to take exercise, it is essential to restore the skin as nearly as possible to a physiological state. For this purpose, I have frequently found very great advantage in resorting, in the first instance, to one or two—

Vapour Baths.—The object of these baths is to excite a free perspiration over the whole body, and to cleanse—not the surface alone of the skin—but the sudoriferous canals. The temperature should be as moderate as is consistent with the effectual accomplishment of this purpose; say from 90° to 100° if breathed, or from 100° to 110° if not breathed. The bath should be such as to allow the vapour either to be breathed or not, according to the feelings of the patient. It has constantly occurred to me to meet—even from patients who have previously been in the habit of using the warm bath regularly—with an expression of surprise at the quantity of *sordes* evacuated from the skin by this measure.

Warm or Tepid Bathing.—Whether the vapour bath be employed or not, this is a remedy rendered totally indispensable by the pathological condition of the skin, in all cases of simple tuberculosis. So far as my own observation extends, in a majority of cases, when they first apply for treatment in that deranged state of the general health which threatens tubercular deposit, and in many children with the slighter scrofulous affections, attention to the function of the skin is quite as imperatively demanded as to the digestive organs; and as much advantage is obtained by purging the skin, as the mucous membrane of the alimentary canal. I have observed the same thing in many cases of incipient tuberculosis pulmonalis. As respects the skin, the first indication is to cleanse it thoroughly. I do not refer to the surface, but, as stated before, to the sudoriferous canals, which are frequently—notwithstanding an habitual perspiring state of the surface—choked up with effete epithelial scales and other sordes. This cleansing process is necessary to bring the surface into the true physiological state, and prepare it for remedies calculated, through the skin, as a sentient organ, to invigorate the frame and improve the sanguification; as the cold bath, the douche, or the shower bath.

For tuberculous subjects, the bath can scarcely be regarded even as tepid under 88°, and a warm bath should not be below 94°, extending from that to 98°; the exact temperature being regulated

by the age, habits and particular state of the health and constitution of the patient. No doubt its use has been carried to excess in many of the German bathing places, and also in this country; and that it may be rendered injurious to tuberculous subjects, by producing relaxation and increasing the debility. I believe the statement, however, that a warm bath has been prescribed for half-an-hour daily, for several months in succession, with advantage (Young); and at the period when tuberculous subjects are verging upon the deposit of tubercle, as well as in the incipient stage of tuberculosis pulmonalis, when that form of febricula exists that characterizes the transition of the blood disease into its more active stage, it is not too much to say, that the warm bath is a powerful auxiliary remedy in preventing or arresting the deposit of tubercle.

V.—THE NERVOUS FUNCTIONS.

Owing to the immense influence, in the animal economy, of impressions made upon the nerves, both those which arise from mental operations as well as those produced by the action of physical agents, the fulfilment of the indication of arresting the predisposition to tuberculosis and preventing the development of the disease, requires that the condition of the whole nervous system should be carefully considered. Many of the causes of the disease produce their effects wholly or in part, by impressions through the nervous system upon the organic functions; and it is scarcely called for, in this place, to dwell on the necessity of tuberculous subjects avoiding all the occasions of undue nervous excitement and exhaustion, and particularly sexual abuses and intellectual and emotional excesses. The considerations stated in the chapter on etiology are quite sufficient to furnish principles of prophylaxis for the direction of patients, under this head. The effects of remedial measures on the nervous functions require also to be sedulously watched, and especially those remedies which owe their efficacy, mainly, to their action upon the whole economy by impressions conveyed through the nerves.

1. *Cold Bathing.*—Of these remedies none are of more importance than the cold bath, which, although acting directly upon the skin, and accordingly influencing all its functions, sanguiferous as well as nervous, produces very powerful effects upon the whole economy through the nervous system. Although warm bathing is indicated

in this disease, cold bathing is not to be rejected; each is calculated to fulfil particular indications and may be employed in different stages, in different states of the constitution, or at different periods. The cold bath is essentially a tonic.

Immersion in water under 85°, or even, for some tuberculous subjects, under 88°, must be regarded as a cold bath. The direct debility of such subjects, and their low power of producing heat, must never be lost sight of in reference to cold bathing. In the first place the shock to the nervous system, from its exhausting effect, when the cold bath is incautiously or injudiciously resorted to is attended with risk from the low state of the vital force of the whole system. A healthy reaction is the object for which the remedy is prescribed, but in tuberculous subjects it often fails, although with them, as with the healthy, when produced in a well marked form, the advantage of the measure is unquestionable. Cold bathing has been recommended to increase the strength of delicate infants, and to render them less susceptible of the injurious influence of cold in after life, but the greatest caution is required at all ages in carrying out this principle. Their low power of producing heat renders it an extremely dangerous proceeding whenever the temperature of the body is below the natural standard. A degree of cold, which, by its effect on the nervous system, would refresh and invigorate a strong subject, child or adult, would produce chill, torpor, and internal or external congestion in a tuberculous subject, and the reaction which results is frequently a feverish condition, instead of the bloom of health and vigour. When the bath produces these effects it is injurious. I have known irremediable mischief arise from the incautious use of the cold plunge bath for the purpose of invigorating the system; and particularly hydrocephalus in infants and pulmonary attacks in adults. The injurious effect of the continuous operation of cold, through the medium of the bath, must also be constantly regarded, and ought to regulate our prescriptions. A plunge into a bath for a moment or two may excite the vital powers and invigorate; whereas, the colder medium, continuing to abstract heat rapidly from a surface already reduced in temperature, is often followed by the most disastrous consequences.

The fundamental rule therefore is, never to allow the cold bath to be employed while the body is below its ordinary temperature. The fear of plunging the body into cold water while it is heated

above the natural standard is a popular prejudice founded on error. It involves the absurdity that it requires to be cooled in order to sustain the effects of cold. That sudden exposure of the body to extreme cold, while highly heated, is unattended by danger, has been proved by the experiments of Dr. Fordyce and Sir C. Blagden, and is confirmed by the customs of the Russians and of the inhabitants of some other countries, who expose themselves for a long time to heated baths and vapour, and suddenly plunge into cold baths or roll themselves in snow. In these instances the previous heat is extremely great, hence the cold may be endured, of a greater degree and for a longer continuance, without producing injurious effects. If the previous heat were less, the cold could not be continued so long with safety.

As stated under the head of "temperature," there are two circumstances especially, either of which being present, prevents the body from sustaining the effects of cold when heated—a perspiring state and debility. The first is a cooling process, and when the result of increased heat, the surface is often already cooled down below its ordinary temperature. Where there is direct debility, or exhaustion of vital power, the action of cold is directly and purely sedative, debilitating, and exhausting. These considerations both illustrate the necessity of caution in the use of the cold bath by tuberculous subjects, and furnish the rules by which its employment is to be directed.

Sea bathing.—The temperature of the open sea on our own shores in the summer and autumn, is from 60° to 70° Fah. Accordingly the sea is strictly a cold bath, and all the precautions already mentioned are necessary in its use by tuberculous subjects. It differs however from the ordinary cold bath by the stimulating effects of the saline matter on the skin, and by the circumstance of reaction following with more certainty. This measure is resorted to with most benefit in the slighter forms of tuberculosis, and especially in scrofulous affections; it was formerly regarded as possessing a specific agency over this form of disease; but more accurate observation has led to the conclusion that its beneficial effects are wholly attributable to its general hygienic tendency when resorted to judiciously.

The cold or tepid shower bath.—Of all the methods of employing the bath by tuberculous subjects, this is unquestionably the safest, and the most beneficial. For that general debility, attended with

a perspiring state of the surface, on the slightest exertion or rise of external temperature, so frequent in the tuberculous constitution, totally apart from the presence of disease of the lungs, there is no one remedy to be compared with the cold shower bath. Tonic medicines are useful; chalybeates are frequently indicated, but this is the most powerful of all remedies. Its advantage over the plunge bath lies in the production of less anhelation and distress at the chest. It should not be adopted while the skin is perspiring for the reasons already assigned. The best time to use it is on rising from bed in the morning, while the body is warm but not perspiring; and it should be repeated daily. In the winter season it is equally efficacious in diminishing the morbid susceptibility to the action of external cold. At this season, caution is necessary as to the temperature of the bath, but more especially as to the temperature of the room in which it is placed, which should not be under 60°, so as to avoid a subsequent chill; and the utility of subsequent dry frictions must not be overlooked.

Nurses, and those who have the care of tuberculous children, should be instructed on the importance of baths, and the management of the skin generally. Rilliett and Barthez adopt a practice which, carried out judiciously, is attended with considerable advantages. Lotions to the skin and bathing are employed as tonics to fortify the constitution; the lotions are used in the first instance warm, and then cold, and in proper seasons are replaced by cold baths. The object of this plan is to habituate children to the contact of cold, and to its effects on the nervous system, as well as to sudden change of temperature. The temperature of the water is at first gradually depressed; the lotions are applied daily, first with warm water, then with cold, not generally nor simultaneously over the whole body, nor for any long continuance; a cold sponge is passed over a limited space for a few moments, and the part then rubbed with a dry cloth, repeating the process successively over the chest, the neck and the shoulders, the arms, legs, feet, and genitals; and as each part of the body is finished, it should be covered so as to promote a healthy reaction. (lib. cit. vol. iii, p. 133.)

2. *The constant and healthful exercise of the sensorial and mental faculties.*—In prescribing change of climate, change of air, exercise, and other remedial measures, their probable effects on the mind of the patient ought not to be overlooked. The etiological influence of the depressing passions has been sufficiently insisted on (p. 466).

A change of climate ought never to be prescribed, or to meet with medical sanction, under circumstances in which it is likely to be attended with permanent depression of spirits. On the contrary, every step which produces pleasurable mental excitement will be serviceable, by improving hæmatosis and nutrition, and increasing the bodily health and vigour. Long journies have very frequently conduced to recovery, an effect attributable to exercise, exposure to the open air, the principle of change of stimuli, and, in part, also to pleasurable mental excitement.

The constant and healthful exercise of the faculty of volition is of immense importance in tuberculous subjects. Mental inertia is quite as pernicious as bodily inactivity. It is a condition which tends to give full effect to the operation of the depressing passions. The operation of volition on the animal economy is absolutely antagonistic to the emotions in its corporeal effects.* Hence we have a psychological remedy, which may be called an antidote to the morbid effects of emotion or of the depressing passions. The very great influence of this remedy can be justly appreciated by those only who have well considered and observed the psycho-physiology of the human mind. Measures for promoting nutrition, for augmenting the sum of the nervous power, and increasing the tone of the nervous system, are not all that a comprehensive system of treatment should aim at; but a uniform and healthful expenditure of nervous and mental energy ought to be promoted. It is in this point of view, that pleasurable exercise, undertaken voluntarily, is so much more desirable than the dull monotony of school exercises, however well regulated. The amusements of children ought always to be regarded in this point of view, they should be directed to the healthful engagement of the mental energies, as in games suited to their age and sex. Even the youngest infants will thrive better in the hands of nurses who bring this principle into play, by talking, singing, and engaging those sensorial and mental faculties that have already developed themselves, than infants whose minds and senses are allowed to remain inactive by the stupidity or monotony of the nurse. Everything that will give full energy and freedom to the animal spirits, in infancy, childhood and youth, should be encouraged; and everything that conduces to continuous calm enjoyment in adult life will promote the curative effects of other agents, and in special

* Sibson, Trans. Provincial Med. and Sur. Association, vol. xvii, p. 294.

cases, will have a more direct agency in relieving the symptoms of the disease.

In fact, at all ages, and in all the relations of life, this principle is available. All who have many years of past experience to reflect on, must have witnessed the salutary effects of that change in a young female's ideas and train of thought—of that healthful stimulus to the volition, and those pleasurable emotions—which succeed to the dull monotony of months and years, of a life painfully sacrificed to some sedentary employment, on entering into an engagement to marry. I have witnessed the tone of mind wholly changed and with it a complete renovation of the health. I have seen all the signs of tuberculosis rapidly disappear, to give place to little short of robust health. Doubtless this is attributable to combined agencies brought into play, but on analysing the causes of ill-health, on the one hand, and the restorative effect of different influences, on the other, it is impossible to overlook the power which the mental stimulus has over the result. This is but one illustration of many that may be derived from social life.

VI.—THE UTERINE FUNCTIONS.

Attention to the *catamenia* in tuberculous females is of the utmost importance. Although the suppression of this discharge is most frequently a symptom of the disease of the blood, there can be no doubt that it is occasionally, also, the exciting cause of the deposit of tubercle. Even in healthy constitutions, it is attended with a vicarious determination to the chest, head, and other organs; and in the tuberculous, it most frequently coincides with congestion of the lungs, dyspnœa, increased general languor and debility, and often with hæmoptysis. On restoring the catamenia by the aid of those remedial measures which are not inconsistent with the treatment of the blood disease, the vicarious symptoms subside; and it frequently happens, that a general amelioration of the tuberculous condition follows. Tuberculous subjects ought, accordingly, to avoid, most consistently, all those circumstances which are calculated to produce any interruption to the menses; as continued coldness of the extremities, mental shocks, and the like; and they ought also, when any interruption occurs, to resort immediately to remedial measures, as stimulating pediluvia, the hip bath, the application of hot vapour, &c., and appropriate medicines when indicated.

There are no circumstances during which the medical and therapeutical treatment of this disease is of more importance than during *pregnancy*, and this importance attaches as much to the child as to the mother. Every influence exerted over the blood and the nutritive functions of the mother is felt by the child, hence, during pregnancy, the whole of the hygienic treatment indicated in this disease is called for in an increased degree; and where the mother is unavoidably surrounded by anti-hygienic influences, they should be ameliorated as much as possible. I have already pointed out the influence of innate constitutional debility in predisposing to the disease, and there is nothing which more decidedly tends to this debility in the offspring, than disorder and disease of the digestive organs, during pregnancy (Clark, Fournet). Hence, a moderate but sufficiently abundant, and generally an unstimulating diet, as much exercise as can be taken without fatigue, in the best available air, residence as much as possible out of the air of dense towns, cheerfulness of mind, early hours, and avoidance of the irrational and injurious customs and fatigues of "society," are called for.

I am inclined to hope, and to believe, that as a disease of the blood, not having passed into an active state, tuberculosis is not only arrested, but under good management may even be permanently warded off by child-bearing; but there is a very general opinion entertained, that where phthisis exists it is arrested during pregnancy, only to proceed more rapidly to a fatal issue immediately after delivery. Hence the greatest care is called for in the management of delivery, and the subsequent treatment. Every possible care is required to prevent and to control undue hæmorrhage, and the most rational principles of management after parturition, to expedite recovery and sustain the strength. Where the predisposition is hereditary and well marked, or the disease actively present, nursing is out of the question; but I cannot say, in my own practice, that I have rigidly adhered to the rule of preventing nursing in all cases; although, where I have known of the hereditary tendency to the disease, even through collateral branches, although the individual may have exhibited few or none of its signs or symptoms, I have always watched this point with anxiety, and have frequently found it necessary to bring it to an abrupt termination.

C.—OF REMEDIAL MEASURES WHICH PROMOTE HEALTHY CELL-GROWTH AND NUTRITION OF THE ORGANIC STRUCTURES.

All the principles, hygienic and therapeutic, for fulfilling the present indication, already detailed under the two first divisions of the subject, are essential here. When we adopt measures for the purpose of improving and perfecting the qualities of the blood, of sustaining the animal temperature, and depurating the economy of effete matters, it is with the ulterior object of promoting healthy nutrition and sustaining the nervous and other manifestations of vital force. Some of these measures have a more direct agency on cell nutrition than others; exercise, for instance, directly wastes tissue, and if it be not carried so far as to exhaust vital power, it indirectly excites nutrition. Hence, under the present head, exercise of the body is of paramount importance; but the circumstance upon which it is most necessary to dwell here is this—a languor of the molecular changes in the blastemata of the tissues is one of the characteristics of the tuberculous habit. The circulation of the blood through the various structures may be moderately active, but the interchange of particles between the intra and extra-vascular nutritive fluids, and the processes of organization and waste, in fibrils, cells and tissues, at the same time slow and inactive; and many of our remedial measures undoubtedly produce a very direct effect in exciting action in this part of the animal fabric.

For the purpose of exciting this interstitial action and promoting fibrillation and cell-growth, *dry friction* is a remedy of by no means trivial importance; particularly in the treatment of infants. It should always follow the use of the bath, and it may be adopted at any time with advantage; and among the passive exercises of this kind *shampooing* is useful, both to infants and adults, in promoting the nutrition and giving firmness and strength to the flaccid and softened muscles. Some, if not all the medicinal agents, which will be described in the next section, also produce effects on the nutritive blastema.

SECTION V.

Of the cure of tuberculosis, the prevention of the deposit of tubercle, and the rendering the deposit inert when aggregated in the organs and tissues.

A.—THE MEDICINAL TREATMENT OF TUBERCULOSIS.

The whole plan of treatment developed in the preceding section

is applicable to the fulfilment of the present indication, subject to such modifications as the circumstances of the case may demand. It frequently happens, that we are called upon to treat a case, where there is nothing beyond an hereditary or acquired predisposition to deal with, and then the principles already developed, chiefly hygienic, may be found adequate to effect the object in view, or it may not be deemed expedient to resort to medicinal agents. At other times, more decided indications of active disease call for more active medical treatment. It has already been stated, that as respects tuberculosis, nature operates, for the most part, by insensible gradations and transitions; there is no such thing as a clear line of demarcation between the termination of one "stage" and the commencement of another. Even as respects the deposit of tubercle in the lungs, a period exists, and frequently a considerable one, during which, the actual presence of tubercle is a doubtful question; and as respects the conversion of the mere predisposition into active tuberculosis, the transition stage is frequently unperceived. Under these circumstances, any arrangement of our indications of treatment must, to a certain extent, be arbitrary; besides which, where the whole economy is involved in one general morbid *crasis*, our most valuable remedies will fulfil many indications at one and the same time.

An immense number of medicines have been proposed in different ages of the world, and in different countries, for the cure of scrofula and consumption; but very few indeed have retained even the shadow of a reputation. A short account of these remedies would occupy a considerable space, and although by no means uninteresting or unimportant, the length to which this work has extended obliges me to omit it. The following account will therefore comprise those medicines only at present in use, and which I regard as alteratives of the blood, and applicable as curative agents in its tuberculous condition.

1. *The preparations of Iron.*—The diminished proportion of red corpuscles in the blood, would lead us, *a priori*, to expect from the use of iron, a very decided influence over the disease in its essence; some experiments by M. Coster* appeared to establish such an influence, as a scientific fact; he appeared to have prevented the occurrence of tuberculosis and the deposit of tubercles by the administration of iron. Animals shut up in dungeons without

* Bul. de l'Academie, Jun. 31, 1840.

light, incapable of moving, and exposed to moist cold, by means of wet sponges hung up in their cages, and fed on their ordinary diet, soon developed tubercles; other animals, placed under similar circumstances, but fed upon ferruginous bread containing half an ounce of carbonate of iron to a pound, presented no trace of them.

Similar results, however, notwithstanding the use of iron from the earliest ages, have never been obtained, that I am aware of, in the human subject. It has been shewn that the diminution of the red corpuscles in the blood is not the primary or the essential character in the disease; and the improvement which follows the use of iron is not necessarily or even frequently followed by a cure. Iron is however, unquestionably, one of our most valuable remedies in the treatment of the blood disease. It may be administered with the most beneficial results at all ages, from the earliest infancy, but, like most other powerful remedies, it requires to be given with caution and upon correct principles.

In scrofulous children, when the proportion of red corpuscles appears to be below the usual standard of even tuberculous blood, the tissues anæmic, and the muscles flabby, its beneficial effects are often very rapid and very decided. In phthisical subjects, under similar circumstances, the effect is the same; and in females of a tuberculous constitution who become chlorotic, its well known influence over the latter disease is equally manifest. Even over tuberculous blood, considered *per se*, iron appears frequently to exert a permanently beneficial influence.

In the tuberculous predisposition, when local disease is only threatened, iron, by its action upon the blood, appears often to exert a very decided and even a permanently beneficial effect. In other cases, its effects are less permanent, and on the discontinuance of its use the patient relapses; the symptoms again giving way on repeating the remedy. In the course of a series of years it has occurred to me to witness, repeatedly, in the same individual, the most unequivocal remedial effects of iron, both in males and females, who have ultimately succumbed to the disease. To obtain its full action, it requires to be employed for a lengthened period; but with occasional intervals, to give the constitution time, as it were, to readjust itself; and it should always be accompanied by the hygienic measures detailed in the last section. Even after tubercles are deposited, it cannot be said to be inert, and in the last stages of phthisis it has been regarded as a remedy of great

power; but I cannot say that I have ever witnessed any very decided benefit from its use at that period.

In the report of the Hospital for Consumption, it is stated that iron was "used in various forms, such as the iodide, phosphate, sulphate, sesquichloride and citrate. During the first stage of the disease, in the absence of pulmonary congestion and hæmoptysis, it has been found useful to the extent of arresting its progress; but the utmost benefits which persons in the later stages have derived from this remedy are, an increase of strength and a temporary improvement of the general health."

Entertaining a high opinion of this remedy, I have watched its action very closely for many years, and conclude that its beneficial effects are dependent upon its assimilation by the blood. Where it is not assimilated it is liable to act as a foreign matter, and often does mischief. Hence, when received into the blood, much depends upon the other principles of nutrition contained in the liquor sanguinis, and much also upon the food and the state of the digestion. When unassimilated it is apt to produce irritation and congestion of the lungs, and probably of other organs; and if persevered in, may be followed by hæmoptysis. Hence its use in phthisis requires to be adopted with judgment, and watched. Where crude tubercles exist, pneumonia has occasionally set in after the employment of iron for a short time; hence I hold it to be a necessary rule that during its use the chest be examined every second or third day. So also, in administering iron in chlorosis, where we have reason to apprehend tuberculosis, or where an hereditary predisposition to the latter disease exists, particularly where large doses are given, chest symptoms and tuberculosis pulmonalis may rapidly supervene.

2. *Cinchona Bark—Sulphate of Quinia.*—From the period at which Morton wrote to the present day, bark has been regarded, by some of the highest authorities, as one of our most valuable remedies in scrofula and consumption; and at the same time, others have condemned its use. It was highly extolled by Fordyce and Fothergill in scrofula, and by May,* Perceval, Kinglake, and others in consumption, and appears to have sustained its reputation, more in external scrofula than in internal tuberculous diseases. It has been administered, for the most part, as a general tonic, rather than with any view of counteracting the proximate cause of the disease. I

* Essay on Pulmonary Consumption, by W. May, M.D., 1792.

have had reason to be highly satisfied with the effects of the sulphate of quinine in the tuberculous constitution; not only where no local disease existed, but in the treatment of various local affections. I can affirm this, especially, of tuberculous (scrofulous) ophthalmia, various cutaneous affections, and chronic bronchitis. In many of these cases the improvement under its use is most remarkable, from its rapidity and its very decided character. I have repeatedly seen an ophthalmia of many weeks duration clear away in a week, with a corresponding improvement of the general health. I have also observed very decidedly beneficial results, either from the quinine alone, or in combination with other remedies, as in the *citrate of iron and quinine*, in tuberculous adults threatened with phthisis; although in such cases, it is unquestionably more apt to disagree than in children, and is upon the whole less beneficial. As to the modus operandi of the active principle of bark, there is less evidence of its reception into the blood, and of its effects upon that fluid, than of some other anti-tuberculous medicines; and it produces more marked effects upon the nervous system; still quinia has been detected in the urine during its use, and it acts upon the infant through the breast milk.

3. *Iodine and its preparations.*—This powerful therapeutical agent is absorbed and carried into the liquor sanguinis, where it appears to produce a specific action; it is conveyed to all the tissues, exudes into the blastema, and enters into the secretions, and in all probability also, into the lymph, being carried back again through the lymphatic glands into the circulation. Its more specific effects appears to be, to excite glandular action and the nutritive functions. It increases the quantity of the urine, the amount of solids which it contains, and especially the urea, and is detected is this fluid. (Glover, lib. cit., p. 252.) Under its use, where it agrees well, the tongue becomes cleaner, the appetite improves, the colour of the surface becomes brighter, apparently from a larger quantity of red blood circulating in the vessels; the secretions generally acquire a more healthy character; and the nutrition of the body is increased. Iodine has been vaunted as a specific in the scrofulous forms of the disease. Lugol expected that we should cure scrofula with iodine, as we cure ague with bark, or syphilis with mercury; but the aggregate experience of the profession has not altogether confirmed this specific agency. Where it has proved most beneficial it has been administered in

association with improved circumstances of hygiene, and where the latter have been omitted, or found impracticable, the iodine has often failed. Mr. Phillips, writing on "Scrofula," refers the good effects of this remedy to "a general alterative action upon the economy.

Iodine, in various forms, has been employed by Drs. Baron, Scudamore, Morton (Philadelphia), Gairdner, Hughes, Mr. Cooper, and by MM. Piorry, Damoiseau (France), and others, in tuberculosis pulmonalis; many of whom give a very favourable opinion of its effects. The preparation most frequently employed is the *hydriodate of potassa*. Dr. Morton regards it as efficacious in the first and second stages. Laennec, Baudelocque, and many others, found it either useless or injurious in phthisis; although they generally admit its curative powers in scrofula. Récamier, Mériadec Laennec, and M. Flandin, regard it as a dangerous remedy, having seen scrofulous subjects under its use become phthisical with a rapidity which could admit of no mistake as to its cause.* *The Proto-Ioduret of Iron* introduced by M. Dupasquier (de Lyons), is also undoubtedly, a medicine of considerable power. M. Dupasquier entertained the most extravagant ideas of its virtues; it cured phthisis in all its stages, converted purulent into mucous expectoration, and healed up caverns; but Laennec, Andral, and others, not only obtained no advantages from its employment in such confirmed cases; but often found that it did positive mischief.

Of the powers of iodine over various local diseases depending for their peculiar character upon a tuberculous state of the blood, no one, I think, who has had extensive opportunities of using it, can doubt; although it is frequently contraindicated by the mucous membrane of the alimentary canal being in a state of irritation. I believe also, that it often fails from being absorbed too rapidly and in too large a quantity into the blood; and by acting as too powerful an irritant of the nervous functions.

Iodine unquestionably possesses anti-tuberculous properties. It may be more appropriate for that stage of the disease of the blood which corresponds with the localization of the disease in the lymphatic system; and may be contraindicated when the blood is matured for the deposit of tubercle; and especially when secondary effects of tubercle in the vital organs have supervened; but when tolerated, it exercises an unequivocal influence over the malnutri-

* Dict. Med. par Monneret, et Fleury, tom. vi, p. 563.

tion of tuberculosis. Under its use the symptoms of the general disease often give way, the patient gains flesh and strength; and the local disease is cured.

4. *Mineral Waters.*—It does not appear that the mineral waters usually employed exert any specific curative agency in the tuberculous constitution. Even in the scrofulous forms of the disease, in which they have been highly extolled, they very frequently fail; and where they prove most beneficial, the result is always referrible to combined agencies, such as change to a purer atmosphere, an improved diet, a greater quantity of exercise in the open air, bathing, and cheerfulness of mind, co-operating with the use of the waters, in the improvement of the health. But the coincidence of these circumstances is often almost all that is required to obtain an improved hæmatosis in tuberculous subjects; and it often happens, that they are most certainly and most conveniently attained, by sending patients to the site of mineral springs with the object of drinking the waters. The mineral constituents must however, not be wholly disregarded, and particularly of those waters which contain iron. It sometimes happens, that tuberculous patients who cannot tolerate any of the preparations of iron, administered otherwise, will derive certain and permanent advantage from chalybeate waters drunk at the natural springs. This is partly explained, I believe, by the minutely divided form in which the iron exists in these waters; and is also owing, probably, to some peculiar saline combinations; from which circumstances it is more certainly, more uniformly, and more permanently assimilated by the blood. Mineral springs which contain a large quantity of chlorides, almost always contain also minute portions of iodine and bromine, and their efficacy has been attributed to these elements.

5. *Cod-liver Oil.*—This is the most important therapeutical agent that has yet been discovered for the treatment of tuberculosis. It had been partially employed for many years in chronic rheumatism, and some other diseases, but Schenk, in 1822, was the first to publish cases illustrating its value in "scrofula." The profession is indebted to Dr. Hughes Bennett, of Edinburgh, for the introduction, in 1841, of its use into this country in tuberculous affections generally.*

It appears to act directly on the elements of nutrition, and has been variously described as a "nutrient," an "alterative," and an

* The Dublin Quarterly Journal, May 1850.

"analeptic." The seat of its operation would appear to be—probably the alimentary canal, (p. 700); the blood; and the organic tissues.

Since cod-liver oil of various qualities is in use, and the particular constituents to which its peculiar powers are attributable, is by no means determined—since, also, great differences of opinion prevail as to its *modus operandi*—it is important to bear in mind all that is known respecting its chemical composition.

There are, as is well known, at least three varieties —white, brown and black. The white oil separates spontaneously first, the brown more slowly, and the black is extracted from the liver by boiling in water after the white and brown oil have been separated.

Dr. De Jongh has recorded the following as the results of the analysis of the three kinds of oil.

100 parts of oil contain :—

	Brown.	Light Brown.	Pale.
Oleic acid, with brown substance (gaduine, and two peculiar bodies)	69·78500	71·75700	74·03300
Margaric acid	16·14500	15·42100	11·75700
Glycerine	9·71100	9·07300	10·17700
Butyric acid	0·15875	.....	0·07436
Acetic acid	0·12506	.....	0·04571
Felic and choleic acids, with some oleine, margarine, and bilifulvin	0·29900	0·06200	0·04300
Bilifulvin and bilifellinic acid, and two peculiar substances	0·87600	0·44500	0·26800
A peculiar substance, soluble in alcohol of 30°	0·03800	0·01300	0·00600
A peculiar substance, insoluble in water, alcohol, and ether	0·00500	0·00200	0·00100
Iodine	0·02950	0·04060	0·03740
Chlorine with some bromine	0·08400	0·15880	0·14880
Phosphoric acid	0·05365	0·07890	0·09135
Sulphuric acid	0·01010	0·08595	0·07100
Phosphorus	0·00754	0·01136	0·02125
Lime	0·08170	0·16780	0·15150
Magnesia	0·00380	0·01230	0·00880
Soda	0·01790	0·06810	0·05540
Iron	A trace		
Loss	2·56900	2·60319	3·00943
	100·00000	100·00000	100·00000

The substance to which Dr. Jongh has given the name of *gaduine* is a peculiar organic body, having the formula, in an isolated state, of C_{35}, H_{46}, O_9; in combination with a base, $N + C_{38}$, H_{44}, O_8. The trace of iron is adventitious, having been derived from the iron kettles.

A discovery is stated to have been lately made by Dr. H. L. Winckler,* who affirms that, instead of containing oxide of glycyl (C_6 H_3), the base of other animal oils, the cod-liver oil contains oxide of propyl (C_6 H_7), in combination with oleic and margaric acids. If this discovery should be confirmed it will tend to the conclusion, that none of the other oils can be substituted for cod-liver oil in the treatment of tuberculosis; since propyl is the basis of a series of compounds differing from those of glycyl. Dr. Winckler makes the suggestion, that the oil owes its efficacy to this peculiarity of its composition; in support of which he states, that *propylamine* (N_4 H_2 C_6 H_7) the result of the action of ammonia, is produced in cod-liver oil and in no other officinal fatty oil; and he has found propylamine in the normal urine and sweat.

As respects the choice of the oil, the German physicians, generally, have preferred the brown oil. De Jongh was of opinion, that the virtues of this variety are superior, owing to its containing a larger quantity of biliary matter and of butyric acid. Some have attributed its efficacy to iodine, and have preferred the variety which contains the largest proportion of this element. Others, regarding it simply as an animal oil, have been indifferent which variety is used. It is now generally agreed that the pure oil, obtained from the fresh liver by the water bath, at not above 180° temperature, is preferable as being less disagreeable. The brown oil in its original state is better than the brown oil decolorized.

In administering cod-liver oil we are conveying into the blood, into the blastema of the organic tissues, and probably into the lymphatic system, not only a peculiar animal oil, oil being one of the essential bases of cell-growth, but we are also conveying with it, in a particular state of solution, minute quantities of several powerful elements which are known to act as stimuli when received into the blood. Of these, iodine, bromine, chlorine, and phosphorus are perhaps the most energetic. It is impossible, in the present state of science, to refer the remarkable effects of the oil to any particular constituent; they result from the united operation of all its constituents, and its peculiar chemical composition shews the necessity of accurate observation of the effects of other agents before we admit of them as substitutes, and the necessity of care in combining the oil with other agents.

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* Annals of Pharmacy, June 1852, p. 175, from Buchner's N. Repertorium für Pharmacie.

That cod-liver oil acts directly upon the blood, producing a very remarkable change in its constitution, we have some ground to assume, from the following analyses :—

1.

Constituents of the Blood of a phthisical man who had gained 14 *lbs weight in three months, and had essentially improved under the use of cod-liver oil; compared with the standard of health. By* Bequerel *and* Rodier.*

	Healthy Male.		Phthisical Patient.
Water	779·0	....	770·6
Blood Corpuscles	141·1	....	143·5
Fibrin.....	2·2	....	4·
Albumen..... 69·4 Extractives and Salts 6·8	76·2	....	81·5
Fatty Matters	1·6	....	·4

2.

Constituents of the Blood at the last venesection, of a man aged 30 *years, under treatment for tuberculosis pulmonalis, who had taken cod-liver oil for some time with much benefit; but subsequently had frequent attacks of hæmoptysis, for which venesection was always immediately prescribed. By* Dr. J. F. Simon.†

Water.....	750·
Solid Residue.....	250·
Fibrin.....	trace
Fat	3·750
Albumen.....	131·
Corpuscles	97·25
Extractive Matters and Salts ..	15·25

In the last case, the blood presented the appearance of a homogeneous, dark red fluid, in which white gelatinous flocks of coagulated fibrin were swimming; it did not coagulate. The proportion of solid constituents surprised Dr. Simon; it was larger than he had ever observed in any other analysis. The fat, when isolated, *smelt strongly of the volatile fatty acid of the cod-liver oil, the odour of which was also strongly developed during the evaporation of the blood to dryness.* There was a considerable quantity of hæmaphæin present, which deeply coloured the extractives and salts. The pecularities are referred by the author to the action of the cod-liver oil and the repeated bleedings.

These analyses appear to shew that the immediate effect of the oil on the blood is to increase the formation of the red corpuscles; and of the solid constituents generally. For although, on com-

* The Lancet, September 13th, 1851, p. 245. † Transl. by Dr. Day, vol. i, p. 261.

paring the analysis by Becquerel and Rodier, with that of the blood in health, the difference is not great, on comparing it with the analyses of the blood in phthisis, by the same physiologists (p. 640), the difference is found to be very great.

The therapeutical powers of this remedy are illustrated in the highest degree in what I have regarded throughout this work as the slighter grade of the tuberculous disease of the blood; exhibited in the various forms of "scrofulous" disease. No known remedy is capable of producing equally beneficial effects—not even iodine. It is undoubtedly more efficacious in some forms than in others, but its efficacy is often most marked in inveterate local affections, as for instance, in many cases of diseased bones; and in no form of scrofula can it be said to be inert. It is less efficacious when the blood affection is ripened for the deposit of tubercle, but even then its value as a remedy is of the highest order. There is reason to believe that when the blood disease has been acquired and shews a tendency to the mesenteric form of tuberculosis, it is more efficacious than in hereditary tuberculosis pulmonalis, (Dublin Journal, p. 431,) as might have been predicated; but even in phthisis, throughout its course, to the formation of cavities and the last stage of the disease, the evidence before us of its beneficial influence, and of its agency over the affection of the blood and the blastema of the tissues, and over cell growth and nutrition generally, is conclusive. The beneficial effects of this remedy are exhibited by an unequivocal improvement of the health and strength of the patient. Both children and adults who are anæmic, atrophied, and debilitated, when they commence its use, become florid, active and strong, and they increase in weight. With these proofs of an improved condition of the blood and an improved nutrition, the more subordinate symptoms of the disease subside, and local disease in every favourable case is either ameliorated or cured.

The efficacy of the oil, as a remedy in the pulmonary form of tuberculosis, is confirmed by the report issued in 1849, by the physicians of the Consumption Hospital at Brompton. This report also proves the efficacy of the remedy in every stage of the blood affection, since it was found by no means inert even in the last stage of the disease of the lungs. The following are some of the more important particulars of 542 cases in which it was administered :—

TABLE XXXVIII.

Results.	First Stage.	Second and Third Stages.	All Stages.
Improved.....	201	141	342 or 63·1 per cent.
Arrested	63	35	98 or 18·1 „
Not Improved.....	29	73	102 or 18·8 „
Total	293	249	542

It was efficacious in both sexes and at all ages. The physicians remark, that when it is recollected, that of the whole number of cases treated at this hospital, the disease was arrested in only 5 per cent., the value of a remedy, under the use of which it appears to have been arrested in 18 per cent., must be considered very great.

The effect of the oil in increasing the weight of the body is shewn by the report referred to. Of 219 cases treated, a gain of weight occurred in 70 per cent., a loss in only 21 per cent.; and in about 8½ per cent. it remained stationary; the amount of increase varied from 1 or 2 pounds during several months, to 1 to 2 pounds weekly, during several weeks.

Thus, then, the facts before us seem to indicate, that the oil increases the proportion of the solid constituents of the blood, and the nutrition of the red corpuscles. It certainly, as a general rule, increases the weight of the body. The statistics of the Consumption hospital also prove, that the increase in the weight of the body is due to some radical and efficient change produced by the oil on the nutritive functions. It is not due solely to the deposition, or the assimilation of the oil itself; for in one instance, 41 pounds were gained in 16 weeks, or 2½ pounds per week; in another case, two-thirds of a pound were gained daily for 28 days, and a pound daily for the succeeding 10 days; and in another, nearly a pound daily for 31 days; while the dose was 1 drachm three times a day, gradually increased, seldom beyond half-an-ounce, although in some few cases, to 1½ oz., for a dose. So that in none of these cases could the quantity of oil taken daily exceed 4½ ounces, and in most cases it did not exceed an ounce and a half, and there is no reason to believe that an additional quantity of fat was at the same time taken in the food.

That the oil does in some manner attack the disease in its essence is proved by these facts, and also by its beneficial effects being

conspicuous in every form, in every grade, and in every variety of tuberculosis. It might be anticipated, *a priori*, that its degree of efficacy should bear a relation to the intensity and duration of the blood disease, and to the degree of organic destruction that may have resulted previous to the commencement of its use; and so we find it; at least in the broader statistics. It is completely and unequivocally curative in many scrofulous affections, indicating the slighter and less inveterate disease of the blood; it is more efficacious in acquired glandular tuberculosis, internal and external, than in phthisis; and least of all so in confirmed (hereditary?) consumption arrived at the last stage.

A most interesting, and I believe important observation, is made by Dr. Walshe,* "The good effects of the oil are, *cæteris paribus*, directly as the youth of those using it; — a singular fact, and which probably may one day (when the textural peculiarities of youth and age are better understood) aid in giving a clue to its mode of action." Let this observation be viewed in connection with Mr. Simon's remarks on the susceptibility of the "young blood" to the tuberculous transformation, and with my own statistical inferences on the greater frequency of tuberculosis, viewed in the aggregate, in the earliest periods of life, and it will be seen how remarkably they support each other. (pp. 412, 574.)

The following observations are collated from the more recently recorded experience of Dr. Hughes Bennett, in Scotland, Dr. Walshe, in this country, Dr. Levick, in Pennsylvania,† Dr. Duclos,‡ Dr. Theophilus Thompson, and others.

The effects of the oil, in most cases, become perceptible after it has been taken about two or three weeks, or even earlier; the symptoms of the tuberculous affection of the blood giving way in the first place, and local scrofulous affections, if they exist, then exhibiting a decided amelioration. If persevered in after this amendment presents itself, even the most severe scrofulous affections, as deep-seated ulcerations and suppuration of bones, will continue to improve, and finally recover. If given in phthisis at the period when tubercle begins to deposit itself in the lungs, the deposition is often arrested, the patient gains weight and strength, the pulse diminishes in frequency, and the catamenia return; and

* London Journal of Medicine. December, 1851.

† The American Quarterly Journal. January, 1851.

‡ Gazette Médicale de Paris. November, 1850.

when an aggregation of tubercular matter has actually taken place, before the supervention of hectic, its effects are often decidedly marked by the disappearance of the physical signs. In the more advanced stages of pulmonary disease, its good effects are exhibited by the signs of the constitutional amendment already described, by a diminution of the cough, dyspnœa, expectoration and hectic, by a cessation of the deposition of tubercle, and after a time, by the closure and cicatrization of cavities; and according to some accounts by a perfect cure of the patient.

Notwithstanding this favourable view, after hectic is completely established the remedy frequently fails to do good. In some instances, as already stated, and particularly in scrofulous cases, the general symptoms resulting from the local affection are ameliorated, the hectic paroxysm with the night perspirations being diminished, the emaciation arrested and the strength increased; and before tubercle is deposited in any vital organ, or before it has softened and ulcerated, this improvement is frequently permanent and the patient recovers; but in such cases, and in tuberculosis pulmonalis, after hectic is fully established, the improvement is too often transitory. The remedy sometimes even increases the hectic, the diarrhœa and the cough. In other cases the patient does not tolerate it at all. Sometimes it agrees, the patient gaining weight and strength, and life being prolonged although diarrhœa continues. In a great majority of cases where it fails to increase the weight of the body it does little good in other respects. It often happens that the disease is arrested for a time, after which it pursues its onward course, and the oil ceases to produce any appreciable effect. Sometimes, notwithstanding its steady employment, the local disease progresses as rapidly as if it had not been given; and in a few instances it proves utterly powerless, both as respects local and general disease.

It is not very material what vehicle it is administered in. Milk, sweet wines, the foam of porter, bitter ale, infusion of orange peel, and many other vehicles are employed. It is recommended by different practitioners to be given an hour before, or an hour or two after, or at meals. Its efficacy appears to be very little if at all influenced either by the vehicle or the time. In my own practice, I have found considerable advantage from one of the daily doses being taken with a small cup-full of new milk and a dessert spoonful of rum, early in the morning. Its employment should

never be abandoned from any dislike the patient may take, but a change of vehicle should be adopted. Great perseverance ought to be exercised in its continuance, even although its use may not be attended with any appreciable benefit; and it should also be persisted in for a long time after the symptoms for which it was prescribed have disappeared.

These rules are founded upon the assumption, of the correctness of which I think there can be no doubt, that it is a remedy of unequivocal power over, and efficacy in, the blood disease, and also that it exerts a favourable influence over all the local manifestations; but its use is sometimes contraindicated. 1. By hæmoptysis; although this must not be taken in too absolute a sense; during active hæmorrhage or congestion of the lungs, or when it appears to produce congestion, it must undoubtedly be dispensed with; although experience has shown, that in more passive hæmorrhage it frequently proves by no means injurious, but serviceable. I have a patient at this time who commenced its use during daily hæmoptysis; he has progressively improved, and the hæmoptysis has subsided. 2. By diarrhœa; the patient frequently cannot tolerate the oil when this symptom exists; and in an irritable state of the alimentary canal it will often produce nausea and vomiting; but this is by no means a universal rule, and by judicious management of the vehicle, and the time of taking the dose, its toleration may very readily be secured. It appears to be generally admitted, that large intestinal ulcers contravene its use; but "the profuse diarrhœa caused by them is not made worse, and diarrhœa, if depending on chronic peritonitis, or secretive change, or small ulcerations in the ilium, is no contra-indication; but, like the other symptoms, it frequently gives way to its use. Where it disagrees with the stomach, impairing the appetite (without itself obviously nourishing), causing nausea, it may be made palatable by association with a mineral acid, and where it produces diarrhœa, this may be prevented by combination with astringents." (Walshe.) 3. Dr. R. Hall, of the Consumption Hospital, Torquay, finds it disagree—when the tongue is morbidly clean, beefy red, glassy, fissured, and the corners of the mouth irritable; also, when thickly furred at the base and the sides, but red at the tip, with a glazed patch of clear red in the centre of its dorsum; also, when large, flat, pale, moist and indented by the teeth, in connection

with general asthema, and its accompanying atonic dyspepsia. (London Journal of Medicine.) 4. By some practitioners it is stated to increase the size of the liver, so frequently enlarged and fatty in this disease; but Dr. Hughes Bennett and others have never observed this effect. 5. Intra-thoracic inflammation contra-indicates its use, but only temporarily so (Walshe). Dr. H. Bennett never found the employment of the oil produce pneumonia.

Among the advantages which result from the use of the cod-liver oil in tuberculosis, in any of its forms, there is none, perhaps, of more importance, than that it sustains the nutrition and strength of the patient, so as to allow of all the other hygienic and therapeutical measures necessary for the recovery of the patient to be adopted and persevered in. The oil should never be administered empirically, but always as a *part* of a *rational* system of treatment. I feel convinced that it has often failed when it might have succeeded, for want of attention to this principle. It should be remembered, that notwithstanding its undoubted beneficial influence, the permanency of its effects is still undetermined; and although it may increase the weight of the body and improve the constitution in some particulars, patients frequently remain pallid under its use, and soon relapse. Exercise in a pure air, a good diet, cod-liver oil, attention to the secretions and excretions, and the bath, are so many hygienic and therapeutical remedies, ancillary to each other, and offering a fair chance of renovating the blood, improving the nutrition, and curing the disease, to which may be added iron and other medicinal agents, as the particular form of the disease or the particular case may require. In Germany the oil has been employed endermically. Klencke ascertained that dogs fattened after being shaved and rubbed with it. Dr. Theophilus Thomson has resorted to the same method at the Consumption Hospital.

It has been stated that any other oil will produce the same beneficial effects, and several experiments have been made to prove this. Dr. R. Hall (lib. cit.) proposes neat's-foot oil as a substitute where the cod-liver oil disagrees; it is to be administered in the same doses and in the same way; it sometimes acts as a gentle purgative, but is uncertain in this respect. Dr. Hall does not know its ultimate efficiency. Dr. Duncan and Mr. Nunn, of the Colchester Hospital, prescribed almond oil as a substitute in upwards of 250 cases (The Provin. Med. and Surg. Journal); they have stated

that it acts in precisely the same manner, and is equally as beneficial as cod-liver oil. They employed it without any adjunct, and also in the following form :—

℞ Ol. Amygdalæ, ℥ ss.
— Olivæ, ʒ ij,
Iodinii, gr. ss. M.
A third part three times a day.

The influence of half an ounce of almond oil daily, upon the weight of some patients, progressing in health under its exhibition, was very great. In one case there was a weekly increase of 2 lbs; in another of 4 lbs. This experiment has however been tried by others with various oils, and, as respects any real advantage in tuberculosis, the results have been negatived. It is worthy of remark, that the Colchester Hospital, in a hygienic and curative point of view, is an admirable establishment, placed on an elevated site and dry soil, which must exert their influence on tuberculous patients.

Other medicines which act on the blood have been employed in tuberculosis. Dr. Crawford proposed the *Hydrochlorate of Barytes*, which was employed extensively in this country, in Germany, and in Italy, with contradictory results, and often with inconveniences from its irritating properties. *Hydrochlorate of Lime*, which occurs in many mineral waters, and also in sea-water, was recommended by Fourcroy, and employed by Hufeland and others in Germany, and especially in Spain. *Mercury* also, in various forms, claims a long list of supporters. In the treatment of scrofula, Mr. Phillips is favourable to very minute doses of *Bichloride of Mercury*; a 20th of a grain twice a day, for instance, combined with syrup of sarsaparilla; he believes that it does not yield in efficacy to Iodine. Although these medicines have been employed chiefly in glandular tuberculosis, as discutients, it is difficult to conceive their *modus operandi* except as blood remedies. *Bromine* has been recommended by some practitioners to replace iodine. *Tannic Acid* is highly spoken of by Dr. S. S. Alison, who appears to have obtained cures of tuberculosis pulmonalis from its use. (London Journal of Medicine, Jan. 1850.) More recently, Dr. Negrier has extolled the virtues of *infusion of the fresh leaves of the Walnut tree;* two or three cupfuls given to children daily, or equivalent doses of a vinous infusion. Its first effects are upon the blood, and

the general symptoms; its influence is slow and durable; the constitution is said to be thoroughly modified, and almost all scrofulous affections radically cured.* Various *vegetable bitters* have at different times been regarded as specifics for the disease.

It may be remarked, of the medicines which experience has found to possess the most decidedly curative power over a tuberculous state of the blood, that there is reason to believe they are absorbed, and being mixed with the liquor sanguinis they produce their primary effect in that fluid. Iron is received into the liquor sanguinis and assimilated by the red corpuscles; this metal is manifestly a stimulus in the blood, promoting nutrition there, and probably acting in a similar manner in the extra-vascular blastema of the tissues, although we have no experimental proof of this; its action appears to be limited more to the blood than the other substances described. Alcohol received into the liquor sanguinis in a very dilute form, and associated with some of the staminal principles of nutrition, as in porter and similar beverages, promotes sanguification and the nutrition of the cellular and adipose tissues; although in larger quantities it acts as an exhausting stimulus of the nervous system, which entirely defeats any such effect. Iodine, an extremely soluble substance, permeating the liquor sanguinis and the organic tissues in a sufficiently attenuated form, stimulates cell growth and nutrition, and the individual fattens, provided the blood contains the appropriate staminal principles of nutrition. Cod-liver oil supplies the blood, not only with an appropriate stimulus to the organizing process, but also with the fatty element, one of the most essential of the staminal principles required for the nutrition of the organized tissues. The stimuli to the act of nutrition, conveyed into the system with the fatty element, appear to exert their effects, more certainly than the other medicinal substances, in the extra-vascular blastema; hence this remedy is the most powerful in increasing the nutrition and weight of the body generally. The effects of these stimuli to nutrition depend upon the materials with which they are brought into contact; when these are assimilable and the processes of digestion and respiration sufficiently well performed, they produce the effect described; under converse circumstances, and particularly when absorbed in considerable quantities, they frequently become irri-

* Edin. Med. and Surg. Journ. Oct. 1850, p. 271.

tant, and promote the absorption and waste of the living tissues; this last effect is often exhibited by iodine and alcohol.

These remedies may be selected, combined, and alternated, upon scientific principles; all possess special powers and produce individual local effects, as iron on the blood corpuscles, iodine on the lymphatic system, bark on the heart and arteries, alcohol on the nervous system; and accordingly none can be employed empirically. Much skill is also undoubtedly called for in making the most appropriate selection, and using the most applicable preparations, in relation to age, sex, temperament, season, climate, the nature and seat of the local manifestations, and the special circumstances of the constitutional disease; but as a whole, I believe they constitute a class of medicines, when judiciously and perseveringly administered, possessing a very high degree of efficacy.

B.—THE PREVENTION OF THE DEPOSIT OF TUBERCLE.

In the treatment of tuberculous subjects the earliest signs of stasis of blood, congestion, or irritation, in any of those organs or tissues in which tuberculous inflammation, or the deposit of tubercle, is liable to occur, laying the foundation for any of the forms and varieties of the disease, many of which are so fatal in their tendency, require to be promptly attended to; and the morbid irritation or determination to be immediately counteracted by therapeutical measures. All the causes of exudation, either of blood or plasma from the vessels, by rupture or transudation, must be avoided. The slightest congestion of the brain in children, however produced—by dentition—by the application of cold to the surface when already chilled—or by blows—may be followed by the deposit of tubercle; or by hydrocephalus, either with or without the deposit of tubercle. The slightest current of air playing upon a chilled surface, or the slightest cutaneous irritation, may produce congestion and tuberculous inflammation, or the deposit of tubercle, in the lymphatic glands. The slightest determination to the lungs may suffice for the secretion or deposit of tubercles in the lungs. Accordingly, the most vigilant attention to the condition of all the organs, and the most prompt application of remedies to counteract the earliest effects of morbid impressions, at a period when they are easily counteracted, is demanded.

The most watchful attention to the respiratory functions, and the state of the respiratory organs, especially, is necessary. Attacks

of pneumonia, however slight, particularly when treatment is neglected, and they are allowed to run their natural course, or the neglect of what is usually called a "cold," frequently leads to an attack of pulmonary consumption, particularly in the subjects of tuberculosis by hereditary descent, and in individuals who, with more care, might have escaped the localization of the disease for years, and even have recovered. A slight, chronic pleuritis, neglected, has often led to the deposit of tubercle in individuals to all appearance robust, but inheriting the tuberculous predisposition. The slightest congestion of the lungs should be sedulously cared for, and appropriate remedies resorted to, for the purpose of restoring the balance of the circulation; so long as it continues, the danger of hæmoptysis is imminent, an occurrence always to be deplored, for, although hæmorrhage in the lungs is frequently a consequence of the deposit of tubercle, it is also frequently a cause; and even if tubercle pre-exist, it may become the cause of a fresh deposit. The respiratory organs in tuberculous subjects have more especially to be most carefully watched throughout the progress of all diseases liable to be attended with irritation, determination of blood to, or congestion, of the structures and organs within the chest, as measles and scarlatina, and particularly those diseases, the causes of which, at the same time, produce direct debility of the whole system, as influenza. The whole chapter on the special pathological anatomy of the disease is but a commentary on these precepts.

Even where tubercle is already established, and especially throughout the first stage of phthisis, these rules of practice are of the utmost importance. The secondary general effects, and particularly the hectic fever, bear a proportion to the amount of tuberculization. Successive deposits of tubercle are attended with successive exacerbations of symptoms; and the progress of the disease bears a relation, not merely to the intensity of the original disease, but to the quantity of tubercle deposited, the local derangement of function and disorganization produced, and the secondary effects on tuberculous blood, resulting from the local disease.

Whatever opinion may be entertained of the necessary fatality, or the curability of the blood disease, or whatever may be its duration and natural termination, there can be no doubt, that the destruction of the vital organs by these pathological processes—their concomitants and sequelæ—is, in an immense majority of the

fatal cases, the cause of the death of the patient. If a tuberculous subject, by careful and vigilant management, escape the causes and the effects of irritation and congestion of the brain in infancy, of every serious scrofulous affection in youth, and of internal tuberculization in adult life, we have almost demonstrative evidence that the blood disease may be spontaneously cured. These therapeutical precepts are of universal application, and it is only on account of the greater frequency of disease in the lungs, that they are more especially applicable to those organs. Believing that either congestion of the lungs or rupture of the morbidly attenuated ramifications of the pulmonary artery, or both, are most frequently the first links in the chain of morbid development in these organs, I hold that the slightest congestion ought to be relieved by *adequate* measures from the first moment of its occurrence. I hold, also, that congestion and stasis of blood in any organ, in a tuberculous subject, has a similar import—in the brain or external glands in tuberculous infants—in the alimentary canal, the mucous or serous membranes, or the nervous or genital apparatus—the relative importance accruing from each depending upon the relative vital importance and the situation of the organ or structure. This vigilance, to prevent and to arrest local, functional and organic injury, requires to be especially exerted at the physiological periods of increased functional activity of the various organs and parts of the body. At the period, for instance, of functional activity during the development of the mental faculties, in childhood, to prevent hydrocephalus, or that of the respiratory functions in early adult life, to prevent phthisis. To the periods of functional or nutritive activity in the skin, the glands, the bones, or the generative organs.

The measures by which local attacks are to be counteracted, are those generally directed by systematic and practical writers; a few remarks only upon one or two points here suggest themselves.

Blood-letting.—As a general principle, blood-letting is contra-indicated in tuberculosis; but this admits of exceptions. In the more plethoric subjects, when congestion or inflammatory action is set up in a vital organ, the loss of a moderate quantity of blood is a smaller evil than the continuance of the local functional disturbance or disease; but no rule can be laid down. The propriety of bleeding, the extent to which it should be carried, and the mode by which it should be performed, must rest upon the judgment of the practitioner in every case individually considered. To proscribe

bleeding in *all cases* is as pure *charlatanry* as to bleed universally in *any* disease; the practitioner who does either must be ignorant of the laws of the animal economy. Tuberculous subjects are liable to every form and variety of acute disease, and the principal points to bear in mind as to bleeding are—the characters of tuberculous blood and the state of the vital powers in tuberculosis. Where the lungs are congested, producing hæmoptysis, or where pneumonia sets in, either primarily or scondarily, as during or after measles and other eruptive fevers, in some cases it would be culpable negligence to omit bleeding; but it must never be overlooked, that the inflammatory action is modified by the tuberculous state of the blood, and the tuberculous nutrition of the organic tissues; the atonic effects are greater, the entonic effects or reaction are less than in a healthy constitution; so, also, the depressing effects of antiphlogistic remedies are greater. The principles of the treatment of acute disease in tuberculous children are well laid down by MM. Rilliett and Barthez, and are completely in accordance with my own opinions and practice; with but little modification they may be adapted for all ages:—1. The treatment should be active, in reference to the state of the constitution, but of short duration; since, if otherwise, convalescence is liable to be prolonged and interrupted. 2. It should be as little debilitating as possible. 3. As soon as the acute affection subsides, no time should be lost in recruiting the strength of the patient, by the adoption of a nutritious and tonic regimen.

Counterirritation, Derivation, and Revulsion.—I am amongst those most favourable to the employment of these remedies, for the purpose of averting local disease, and of arresting its progress; but I believe that they are rarely carried out adequately as respects the pathological condition for which they are intended to prove antagonistic. I have seen a seton in the arm promote the healing of chronic tuberculous affection of the glands of the neck, and shorten its duration. I have seen setons and caustic issues contribute to the relief of pulmonary congestion, and—as far as human foresight could determine—prevent the deposit of tubercle. I have certainly seen pulmonary tuberculous disease remain stationary for a long time under their use. These remedies are the more unequivocally and the more rapidly efficacious in proportion as they are resorted to early after the commencement of local symptoms. At the Consumption Hospital vesication by means of a strong solution

of iodine and iodide of potassium, in alcohol, applied with a camel's hair brush, was found "remarkably beneficial." These local remedies, so far from interfering with the constitutional treatment, have probably a beneficial effect on the state of the blood.

Tuberculous subjects ought to be habituated to the use of the *stethescope*, the *spirometer*, and the *balance*. When these mechanical instruments are occasionally applied to their appropriate uses, during the periods of comparative health, much less importance is attached to them, and that dread so frequently experienced, is prevented when actual disease occurs; a matter by no means of trivial importance. I have known even a male patient so nervous on being asked to respire into a spirometer, an instrument which "his philosophy had never dreamt of," that the observation made was totally valueless; and the same thing constantly occurs when the stethescope is first applied to females.

The Respirator.—No tuberculous subject should be without this instrument, and particularly those who are subject to laryngeal or bronchial irritation; and those who are often prevented exercise in the open air by a great sensibility to the effects of cold. The paramount necessity for free respiration in this disease has been fully exemplified in various parts of the work, and this instrument was introduced by Mr. Jeffreys, for the purpose of facilitating respiration, increasing the function of the lungs, and promoting the expansion of the chest. Its great merit is that it enables patients to take exercise out of doors when they would otherwise remain at home; particularly in the spring season, and during easterly winds. These winds are often injurious in this climate by their aridity, which the instrument counteracts; keeping the air respired warm and moist, and thereby soothing to an irritated surface. Another advantage is, that it enables the patient to habituate himself to breathe, even in the open air, with the mouth open, thereby facilitating respiration. It also tends to sustain the animal temperature, and prevents the necessity for more violent exercise than a tuberculous subject can undergo without injurious consequences. At the same time, the respirator requires to be used systematically and with judgment; for the want of this, many tuberculous subjects discard it. They find it "oppresses" them. This arises from the state of the surface of the body, the temperature and hygrometric state of the external air, and the quantity and kind of clothing. The respirator is constructed of various

degrees of power, and the tuberculous invalid ought to be carefully instructed in the mode of varying its employment. According to the principles advanced in this work for the treatment of tuberculosis, the respirator would only be required out of doors, but when it is impracticable to command warmth in the dwelling house of the patient, it should be employed, upon the same principles and to fulfil the same indications, within doors.*

C. OF RENDERING TUBERCLE INERT.

I have not ventured to lay down an indication for promoting the absorption of tubercles, although thoroughly convinced, that after the blood is restored to its healthy state, this process often takes place. Iodine, and particularly the hydriodate of potassa, ioduret of iron, aud cod-liver oil, have had the power of directly promoting the absorption of tubercle assigned to them, but as respects either, it is certainly not at present established on sufficient proof. Where, unfortunately, the morbid element is already deposited in the lungs, whatever stage it may have arrived at, our object is, at all events, to maintain it as long as possible in a quiescent state by the measures and precautions already detailed; and to improve the condition of the blood. The longer we succeed in this effort, the greater the chance of ultimate recovery; and the remarks made in a former part of this volume, under the head "Prognosis," as well as the recoveries which occasionally take place, are calculated to inspire hope, in every case in which no vital organ is so far destroyed as to be incompatible with continued existence.

Conclusion.

In exemplifying the rational indications required to be fulfilled in the treatment of tuberculosis, regarded as a disease of the blood, I wish it to be understood, that I have made no attempt to lay down a complete system of hygiene, nor do I pretend to have entered into all the details of which the subject, in its extensive ramifications, would admit. It has rather been my aim to illustrate the principles of treatment, in accordance with the views developed in this work of the nature and causes of the disease, and especially to describe those measures upon which our chief reliance is placed for converting unhealthy into healthy blood, and for securing the absorption and elimination of the *imperfectly organized*

* Views upon the Statistics of the Human Chest, by Julius Jeffreys, F.R.S., 1843.

tissues of tuberculous subjects, and the assimilation of more *perfectly elaborated and organized materials*, under an improved condition of the *vital force*. For this purpose, our most powerful resources appear to be: 1. The respiration of a pure, elastic, and moderately dry atmosphere of medium temperature. 2. The use of a sufficient quantity of food, containing a due proportion of all the staminal principles essential to form a pabulum for healthy blood. 3. An amount of regular and healthful out of door exercise, proportionate to the available vital force of the individual; so as to maintain, in a physiological state, the action of the heart and arteries, the due circulation of the blood, the molecular changes in the blood itself, the animal temperature, the secretions, the excretions, the appetite, digestion, and secondary assimilation. 4. A uniform and healthful flow of the animal spirits, a due excitement of the nervous system generally, and a moderate but not excessive exertion of the intellectual faculties. 5. The appropriate administration of such medicines as exert an alterative action on the blood. 6. The avoidance of hereditary transmission, and of all those errors of sex and reproduction by which the disease can be engendered. Under the hygienic circumstances embraced in this category, tuberculosis could never be acquired; and by adopting these measures consistently, and carrying them out efficiently, I believe that, even in confirmed cases, the disease may frequently be cured.

Whoever reflects, that the origin and perpetuation of this disease, are attributable less to the nature of man's constitution and the necessary effects of the agencies by which he is surrounded, than to his own negligence or contempt of natural laws, his ignorance, his imprudences, or his follies—whoever considers, the importance to the happiness of the whole human race of the questions herein contained, and admits, that the faculties of man are bestowed that he may avert evil and promote his own welfare—whoever allows, that the subject has never yet been thoroughly investigated, and that the blood is an open and fertile field of discovery—will not complain that this book is too *voluminous;* he will rather regret, with the author, that the task which is now completed, had not been undertaken with sufficient leisure to render it more perfect, and with opportunities of obtaining a more satisfactory solution of many important problems.

APPENDIX.

A.

THE CHRONOLOGICAL HISTORY OF TUBERCULOSIS, p. 372.

No appropriate place presented itself in the body of the work for the introduction of this subject, and in fact it admits at present of but very little elucidation. Statistical science is of modern data, and without it, we can form no accurate opinion of the frequency of a disease, at any age or epoch, and no comparison of its relative frequency at particular epochs. The statistical records of different countries are also by no means sufficiently matured to admit of just comparisons to any great extent, of the relative frequency of the disease at particular periods in one country as compared with another. This deficiency is now being supplied, and from year to year we shall be furnished with data from public *Registries,* by which the chronological history of the disease may be determined.

That tuberculosis was a frequent disease among the Greeks, at the earliest periods of the annals of medicine, is plain from the works of Hippocrates (Syd. Ed., vol. i, p. 353-5); and that it was common among the Romans, both in the form of scrofula and of phthisis, from the therapeutic indications of Celsus, the minute and accurate description of Aretæus, and the works of Galen. In France, its great frequency at an early period may be inferred from the practice of the Royal touch for the "King's Evil" being said to be traced back to Clovis, who reigned in the fifth century; and in England, by the same practice being referred to Edward the Confessor, A.D. 1041. In fact, the extreme frequency both of scrofula and consumption, in all civilized communities, is established by every record that has been preserved.

From statistical tables kept in some continental towns, both scrofula and phthisis appear to have been on the *decrease* of late years. Tables kept in Würtemburg exhibit this as respects phthisis; a decrease also appears to have taken place in Stuttgard since 1787. The statements respecting America are contradictory; by some it is supposed to have decreased of late years, and by others to have increased. There is reason to believe that the Aborigines of various

countries were not subject to it in their uncivilized state, but have become so with the progress of civilization.

The data we at present possess to form an opinion on the relative frequency of the disease at different periods, in this country, are also extremely imperfect. Mr. Phillips estimates, from the number of persons who resorted to the Royal Touch in the reign of Charles II, that the population of the metropolitan district being taken at 600,000, the number of cases of *scrofula* might be 20,000; or about 1 in 30 of the population were affected with the disease so as to require relief; whereas, from the dispensary records of the present day, not more than 1 in 100 are so affected. The Bills of Mortality for London also shew a decrease in the frequency of *consumption* during the last century and a half; as appears from the following Table, constructed from one furnished by Sir J. Clark (lib. cit., p. 210), which I have amplified by the addition of such particulars as the Abstracts of the Reports of the Registrar General before me contain.

TABLE XXXIX.

The Mortality in London from Phthisis, and also from the four principal forms of Tuberculosis during the Eighteenth and Nineteenth Centuries.

Period.	Population.	Average or Absolute Number of Deaths.				Yearly Deaths per 1000 living.			Proportion per 1000 Deaths.	
			From All Diseases.	From Consumption.	From Tuberculosis.	From All Diseases.	From Consumption.	From Tuberculosis.	From Consumption.	From Tuberculosis.
1700	665,200	1700 to 1710	20,943	3055	Scrofula, Phthisis, Tabes Mesenterica, and Hydrocephalus	31	4·	Scrofula, Phthisis, Tabes Mesenterica, and Hydrocephalus	145	Scrofula, Phthisis, Tabes Mesenterica, and Hydrocephalus
1750	653,900	1750 to 1760	20,349	4373		31	6·66		214	
1801	777,000	1800 to 1810	18,890	4979		24	6·		263	
1811	888,000	1810 to 1820	19,061	5491		21	6·17		288	
1821	1,050,500	1820 to 1830	20,676	6552		19	6·2		316	
1831	1,233,000	1831	20,910	4735		16	3·8		226	
1841	1,948,369	1841	45,284	7326	9431	23	3·7	4·8	160	208
1847	2,143,055	1847	60,442	7010	9948	28	3·2	4·6	115	164
1849	2,206,076	1849	68,432	6317	8982	31	2·8	4·	92	131
1850	2,240,289	1850	48,579	6137	8539	21	2·7	3·8	126	175
1851	2,373,799	1851	55,354	7027	9823	23	2·9	4·1	109	177

This table shews, either, that the returns being now more accurate, tuberculosis was not so frequent formerly as represented; or, that since the commencement of this century, the disease, according to the mortality, has declined in frequency. It was my anxious desire to include in this work a table drawn from the census of 1851, to correspond with Table XIX; but the returns are not yet published by the Registrar-General. With such a table, many interesting comparisons may be made; we shall have better grounds to form an opinion of the relative frequency of the disease at several recent periods, and also of the effects of the altered habits of the population arising from its greater prosperity, from railway travelling increasing the habits of locomotion, and other changes; or of the influence exerted over the aggregate mortality by the general use of cod-liver oil.

Notwithstanding the very great deficiency of data, I conclude, not only, (with Mr. Phillips), that scrofula is less prevalent in this country than formerly, but that tuberculous diseases generally are much less frequent than in the 17th and 18th centuries; that there is ample justification for the observations made at pages 485 and 486 of the body of the work, respecting the control we possess over the disease, and fair grounds for the belief that its frequency is at present on the decline.

B.

CAUSES OF TUBERCULOSIS, p. 418.

The employment of impure vaccine lymph was found by Dr. J. B. Thompson to be, not infrequently, "a cause of tubercular disease in the East and in the colonies." Dr. Thompson also refers tubercular disease in savages to the use of impure vaccine lymph, as it was formerly unknown to them. This statement is not substantiated by facts, but a paper is promised on the subject. *Report of the Meeting of the Medical Society of London,* Feb. 8th, 1852.

C.

THE GEOGRAPHY OF TUBERCULOSIS, p. 513.

On the Atlantic coast of the Isthmus of Panama endemic remittent fevers are extremely prevalent; a very large proportion of strangers to the climate are affected by them. At the railway company's hospital, Buyo Soldado, Dr. Lidell records, that of 382 cases of disease admitted, from Jan. 1st to May 1st 1851, all being Europeans or Americans, there were 250 cases of climate or remit-

tent fever, only four of tuberculosis pulmonalis, and none, as it would appear, of any other tuberculous affection. At the same time, Dr. Lidell states, that the climate is most inimical to persons in confirmed consumption, who invariably died or sought prolongation of their days by precipitate flight; it destroyed them "as with the sword." The climate is a "perpetual summer," being extremely hot, the range of the thermometer from 69° to 89° in the shade; excessively humid; and the atmosphere loaded with noxious exhalations.*

D.

THEORIES OF TUBERCULOSIS, p. 548.

Dr. Matthew Troy, of South Carolina, has lately advanced a theory that tubercle is the solid matter of the cutaneous excretion, particularly of the sebaceous follicles, retained in the blood until deposited in other organs, where, its fluid particles being absorbed, it becomes tubercle.† The mucous membranes being most nearly allied in function to the skin, is the most frequent seat of the disease. Its morbid condition in tuberculosis, and particularly its hardness and dryness, are insisted upon. The granular and oily matter of tubercle are regarded as the material of the oily and albuminous secretions of the sebaceous follicles. The beneficial effects of warm climates, vigorous exercise in the open air, friction, and rubefacients applied over a large portion of the surface, are explained on this view, and many physiological and pathological principles are brought forward in support of the theory. The paper, however, contains no new facts.

E.

STATISTICS OF TUBERCULOSIS—RELATIVE FREQUENCY IN THE SEXES, p. 396.

Dr. Boyd found, at the Marylebone Infirmary, that seven males died from phthisis to four females, in 206 cases. (lib. cit.) Dr. Chambers, in his "*Decennium Pathologicum*," now publishing, (Med. Times, Aug. 1852,) has shewn, that of 2529 patients who died in St. George's Hospital, during ten years, 550, or nearly 25½ per cent. presented tubercles. There were 388 males, and 160 females, and comparing these numbers with the total number

* The New York Journal of Medicine. May 1852.

† The American Quarterly Journal, July 1852.

of deaths, of males and females respectively, "in every 100 men there were more than 27, and in every 100 women not quite 22 affected with tuberculosis." Dr. Chambers states that "the male tendency is therefore to the female as 100 to 78·9."

These are instances, which may be appended to those given in the text, of the fallacies liable to accrue, if we draw inferences from limited statistical data. In 349,892 deaths from phthisis recorded in these realms, 184,060 were females, and only 165,832 males; and 8,775,174 females, furnished a mortality of 28,234, whereas 8,368,914 males, furnished only 25,083. (Table XIX, p. 408.) If it be said that the wider statistics abound in errors, these occur both as to males and females, and in such large numbers it is not likely that any inequality in this respect could reverse the results. There are many causes by which the statistics of hospitals are liable to be very greatly influenced. Particular classes of the community avail themselves of hospital relief more than other classes. When artisans and their sons become disabled by accident or disease, the hospital or the workhouse is their only resource, and there they die; but their wives or daughters, under similar circumstances, more frequently remain at home to the last. Many other circumstances in explanation will be found in the body of this work.

An important feature in Dr. Chambers' statistics is, that he has noted the proportion of cases in which tubercle was found *post mortem*, whether the patient died of tuberculosis or not; which will facilitate the study of the relations of tuberculosis to other diseases (p. 597); but this part is not yet published. In 550 subjects, in which tubercles were recorded in some part of the body, the lungs were free in 47. I have furnished a table, (VII, p. 359,) of 1136 cases, from various pathologists, out of which the lungs were free in 106 cases. But this table comprises 462 cases of children, which gave 86 cases; Dr. Chambers' table comprises only 42 cases, 15 years old and under, and of these, five only furnished tubercles in other parts of the body exclusive of the lungs; so that the proportion of cases of tubercle in the *adult*, exclusive of the lungs, is greater than previously recorded. This proportion is no doubt increased by all cases being included in which tubercles were detected, whatever the disease of which the patient may have died.

F.

STATISTICS OF TUBERCULOSIS. EFFICACY OF COD-LIVER OIL, pp. 520, 525, 746.

In the third edition of Dr. George Wood's "Practice of Medicine," * recently published, the mortality from phthisis in relation to the mortality from all causes, in one of the principal cities of the United States, is thus represented:—

Philadelphia	1810 to 1820	10 years	1 in 6·38
,,	1830 to 1840	10 years	1 in 7·03
,,	Mean of....	20 years	1 in 6·705
,,	1840 to 1850	10 years	1 in 6·76
,,	1850 and 1851	2 years	1 in 8·33
,,	1851.....	1 year	1 in 8·43

The disease would thus appear to be on the decrease; but the most important circumstance is, that while the average mortality, during a long series of years previously, was about 1 in 6·76, or 14·8 per cent. in the years 1850 and 1851, during which cod-liver oil has been in extensive use, the proportion has fallen to 1 in 8·33, or about 12 per cent. In the latter of these two years the mortality has been smaller than in the former, being 1 in 8·43, or 11·86 per cent. Dr. Wood states, that "there has been nothing to which this result can be ascribed, unless to the very general employment of the oil," and he infers that a diminution in the general mortality from phthisis, as evinced by the statistical reports, is ascribable to this remedy.

G.

ETIOLOGY OF TUBERCULOSIS; TUBERCULOSIS IN ANIMALS, pp. 354, 373, 420, 485.

Without entertaining any doubt that tubercular disease is artificially producible, Mr. Simon, of St. Thomas's Hospital, maintains the absolute *infrequency* of its production. He states, that the difficulty of producing it in any one generation, free from the taint, amounts almost to impossibility. That the influences by which it has become a permanent element in the human constitution have probably affected several generations in succession. But this view is sustained by a very great limitation of the meaning of the term "tuberculous or scrofulous disease." Mr. Simon separates from the category of "scrofulous" affections all those disorders of defec-

* Vol. ii, pp. 63, 95.

tive nutrition which I have treated throughout this work, as receiving their specific qualities from the tuberculous blood of individuals in whom the tuberculous constitution is either hereditary or acquired; and limits the term "scrofula" to those diseases only in which tubercle is deposited. The slighter affections, which may be readily produced under the influence of defective nourishment, are very liable to occur, Mr. Simon admits, in the subjects of tubercular disease, but life is compromised in such cases by the local inflammations, and other affections which occur, and not by tuberculous disease.

In support of this view also—the non-producibility of tubercle—Mr. Simon states, that many experiments on the lower animals, in which tubercle is said to have been artificially produced, are fallacious.* He examined the so-called tubercular liver of numerous rabbits, and instead of finding the morbid production composed of tubercle, he found, with the aid of the microscope, that the whole mass consisted of the minute oblong eggs of some entozoon; and also, on enquiry, that this affection of the liver is very common in tame rabbits and does not appear to be inconsistent with the general good health of the animal. Mr. Simon also tried to produce tubercle artificially in rabbits but without success, and he never saw tubercle in a rabbit. Not only in rabbits, but in sheep, cats, and dogs, a very large proportion of the alleged tubercular deposit artificially produced, prove, on careful examination, either to be instances of parasitic development in the substance of the organs or to consist of some other morbid product utterly unlike human tubercle.

But Mr. Simon admits that change of climate does apparently tend to develope tubercle, and that we can facilitate the development of the disease by a change, especially from a warmer to a colder climate; he admits also the influence of bad air and diet, want of exercise and the like, in arousing the energy of the tuberculous disposition, if it be latent. He admits, also, the artificial production of the fatty degeneration of certain tissues, which he regards as very nearly akin to tubercle.

Mr. Simon's views are always deserving attention, but the facts in the text are opposed to them.

* Lecture on General Pathology, p. 166. 1850.

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