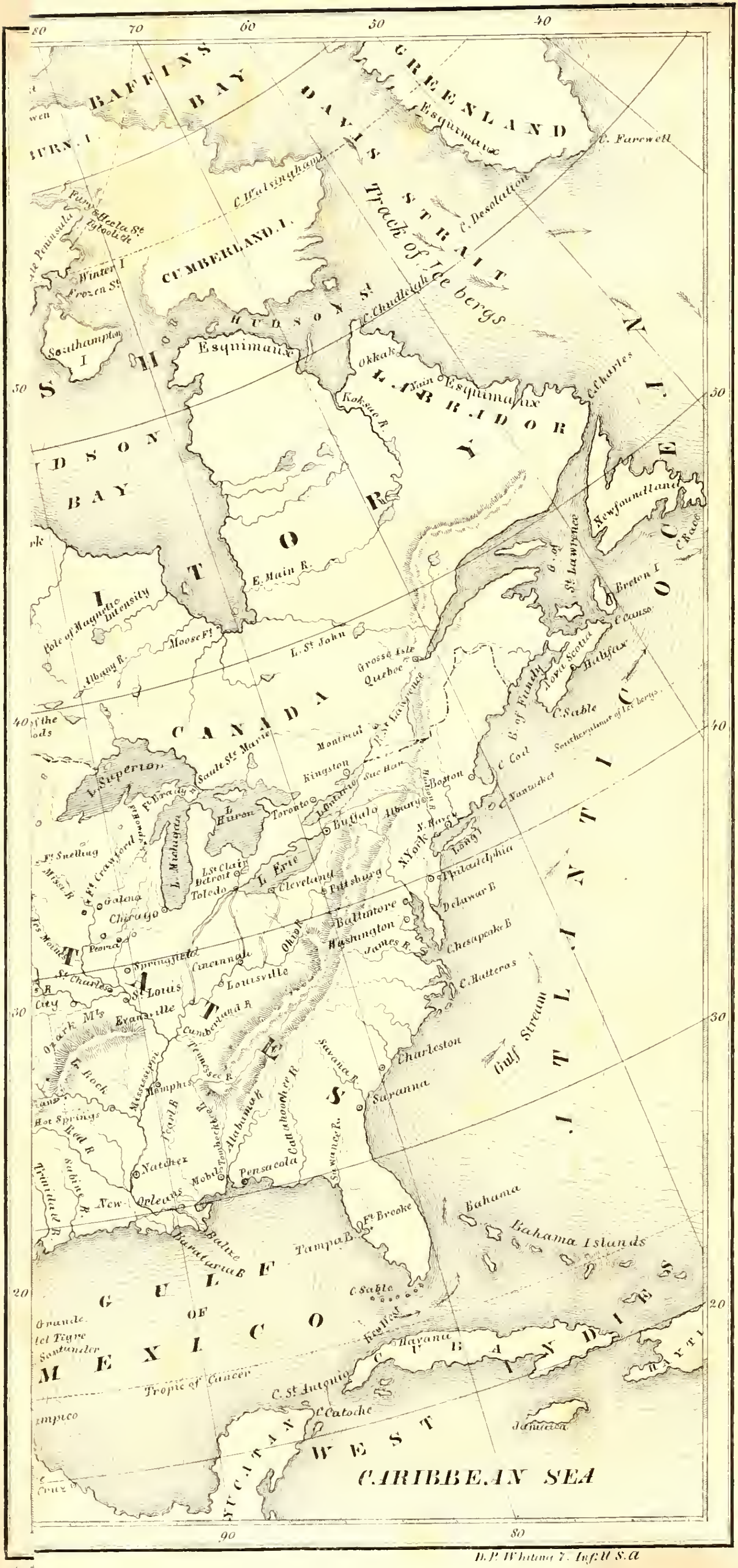

D. P. Whiting 7. Inf. U.S.A.

A

SYSTEMATIC TREATISE,

HISTORICAL, ETIOLOGICAL, AND PRACTICAL,

ON THE

PRINCIPAL DISEASES

OF THE

INTERIOR VALLEY OF NORTH AMERICA,

AS THEY APPEAR IN THE

CAUCASIAN, AFRICAN, INDIAN, AND ESQUIMAUX VARIETIES OF ITS POPULATION.

BY DANIEL DRAKE, M. D. 1785-1852

CINCINNATI:
WINTHROP B. SMITH & CO., PUBLISHERS
PHILADELPHIA: GRIGG, ELLIOT & CO.
NEW YORK: MASON & LAW.

1850.

PL. I

HYDROGRAPHICAL MAP
of the
INTERIOR VALLEY
OF
NORTH AMERICA
EXPLANATIONS
Salt Water
Fresh Water
Summer Ice
Mountains
Towns
Forts
ARCTIC OCEAN
RUSSIAN TERRITORY
BRITISH TERRITORY
UNITED STATES
MEXICO
CANADA
GREENLAND
LABRADOR
PACIFIC OCEAN
ATLANTIC OCEAN
HUDSON BAY
BAFFINS BAY
DAVIS STRAIT
HUDSONS St
GULF OF MEXICO
CARIBBEAN SEA
WEST INDIES
Pole of Cold
Pole of Magnetic Intensity
Track of Ice bergs
Gulf Stream
Tropic of Cancer
Rocky Mts.
Mexican Cordilleras
Indians
Bahama Islands
COCKBURN I.
CUMBERLAND I.
Southampton I.
Newfoundland
C. Farewell
San Francisco
Monterey
San Diego
C. St Lucas
C. Corrientes
Chihuahua
Santa Fe
St Louis
Chicago
New Orleans
Galveston
Charleston
Savanna
Washington
Baltimore
Philadelphia
N. York
Boston
Quebec
Montreal
Kingston
Toronto
Buffalo
Cleveland
Detroit
Toledo
Cincinnati
Louisville
Pittsburg
Pensacola
Mobile
Natchez
Memphis
Tampa B.
L. Superior
L. Michigan
L. Huron
L. Erie
L. Winipeg
Mississippi
Missouri R.
Arkansas R.
Red R.
Ohio R.
Colorado R.
Columbia R.
Rio Bravo del Norte
Saskatchawan R.
Mackenzie R.
Front page
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CINCINNATI:
Morgan and Overend, Printers.

TO

THE PHYSICIANS

OF THE

INTERIOR VALLEY OF NORTH AMERICA,

THIS

IMPERFECT ATTEMPT

TO LAY

AN EXTENDED FOUNDATION

FOR

A HISTORY OF ITS DISEASES,

IS RESPECTFULLY INSCRIBED,

BY THEIR FELLOW LABORER,

THE AUTHOR.

PREFACE.

The object proposed in the following work, is to give an account of the causes, symptoms, pathology, and treatment, of the principal diseases of an extensive portion of North America — its Interior Valley. In exploring it, for the purpose of collecting facts, the Author endeavored to leave behind him all opinions but the single one, that he who would observe correctly, must have no theories either to maintain or destroy.

To say that he has always been faithful to this rule of observation, would be rash; but, he *may* say, that he has sincerely and earnestly desired, to keep himself under its sway. He may affirm, still further, that it has been his constant aim, to purify from error, the facts he was collecting; and he trusts, therefore, that all the more important will be found substantially correct. Nevertheless, the country to which the work relates, is of such vast geographical extent, that he cannot doubt, but that every reader will detect some errors, in what relates to the topography, climate, or diseases of his own locality.

But while the object of this work is to embody facts, drawn, by personal intercourse, from numerous living physicians, or from publications made by them and their predecessors, and to combine the whole with his own observations, he has not been unmindful of the discoveries and improvements in etiology, pathology, and practice, of older and more enlightened countries; but sought, as far as they have become known to him, to amalgamate the foreign with the indigenous, and thus present to his brethren of the Interior Valley, a book of practice, so full on all the diseases of which it treats, as to make it a useful manual for daily reference. He is obliged to admit, however, that, while seeking after knowledge among the physicians of his own country, he could give but little attention to the writings of those who live in other countries.

Long journeys of observation, repeated through a large part of several years, with elementary teaching in winter, have much abridged the time for bibliothecal research; and, perhaps, even diminished the taste for that mode of inquiry.

Extensive as his explorations have been, large regions of country remain unvisited; and many conclusions, at which he has arrived, might possibly have been different, had the facts, which those regions could have furnished, been obtained by him. Yet, as his personal examinations were carried through eighteen degrees of latitude, and nearly as many of longitude, he trusts that facts which may, in some degree, stand as representatives of the whole, *have* been collected; and, therefore, that no general conclusion will be found radically wrong.

As announced on the title page, it is the design of this work to treat of the diseases of the Caucasian, Indian, and African Varieties of our population, in contrast and comparison with each other — the first being the standard to which the other two are brought. For this purpose, no other country presents equal advantages; since, in no other, do we find masses of three varieties of the human race, in permanent juxta-position. There is, moreover, a fourth variety, the Mongolian, represented by the tribes of Esquimaux, whose huts of snow are scattered across the northern extremity of the Valley; who subsist on a simpler diet, and live in a lower temperature, than any other known portion of the human race; and, therefore, present, in their habits and physiology, many points of interest, to which he has given such attention as the books of voyages and travels, have enabled him to bestow.

In his traveling intercourse, with his brethren and collaborators of the Great Valley, from Florida, through to Canada, inclusive, although going among them generally, without letters of introduction, he has, with very few exceptions, been received in the kindest manner, and afforded every facility in their power; for which he cheerfully makes this public acknowledgment. To designate, by name, all who manifested a high and encouraging interest in his enterprise, would be to form a catalogue too long for introduction here; but of gentlemen residing without the United States, he is not at liberty to omit the names of Professor Joseph Morrin, of Quebec, Professor Archibald Hall, of Montreal, and Captain John Henry Lefroy, of the Royal, Magnetical, and Meteorological Observatory, Toronto, as having afforded him important assistance.

While prosecuting his researches, he visited the larger part of the military and naval posts of the Interior Valley, both American and British, bearing a letter, explanatory of his object, from Major General Scott, and received, at each, such facilities as were practicable.

He desires, also, to record the names of several young gentlemen, who have rendered him various kinds of aid, in the preparation of the work for the press. They are Doctor Charles A. Hentz, Mr. Theodore S. Dana, and Mr. Charles A. Caroland, students of medicine, and Mr. David Smith; each of whom performed the part assigned to him, in the most faithful and zealous manner. Notwithstanding this, however, it is feared that, in the statistical portions, some errors may be found, though none he trusts of great magnitude.

The hydrographical map, which forms the frontispiece of the book, seemed indispensable to its plan. The reader will perceive, that it is not designed to represent civil and political divisions; but to assist in connecting what is said on medical topography, climate, and the limits imposed by latitude and altitude, on certain diseases, into one system. It was drawn by Major D. P. Whiting, U. S. A., who also drew several of the topographical maps; the remainder and larger part were from the accurate pencil of Captain C. A. Fuller, U. S. Civil Engineer. They were all executed under the author's inspection, out of the best materials he could command; for a part of which, together with many useful suggestions, he is indebted to the veteran Topographical Engineer, Colonel Stephen H. Long, U. S. A. The engravings are on stone, by a young German artist, Mr. A. Wocher, of Cincinnati, and will, the author trusts, be found not unworthy of the typographical execution, under the supervision of Mr. Charles H. Bronson; whose abilities and taste as a practical printer, have overcome many difficulties, resulting from the introduction of more than a hundred Statistical Tables, and from the absence of the Author, at the University of Louisville, during the past winter, while the work was in the press. Finally, the Author desires to express his obligations to Messrs. Winthrop B. Smith & Co., for their willingness to turn aside from their ordinary business, and become the publishers of the largest original work which, as yet, has been written and printed in the Interior Valley; thus rendering it, in all respects, an indigenous production.

The germ of this work, was a pamphlet entitled "*Notices Concerning Cincinnati*," printed for distribution, forty years ago. The greater part of the Interior Valley of North America, was at that time a primitive wilderness. Ten years afterward, the author formed the design of preparing a more extended work, on the diseases of the Ohio Valley; but being called to teach, he became interested in medical schools, which, with the ceaseless labors of medical practice, for the next twenty years, left no time for personal observation, beyond the immediate sphere of his own business. Meanwhile, settlements extended in all directions, with which the area of observation expanded; and the plan of the promised work, underwent a corresponding enlargement. He could look upon this long delay, without regret, if he were conscious, that his work had, thereby, been rendered proportionally more perfect; but he is obliged to confess, that the labors of a pioneer in many things, have not been auspicious, to a high degree of perfection, in any; and, that a new country, with its diversified scenes and objects, is not favorable to the concentration of attention, upon any one.

He expected to have introduced into the first volume, the article, Yellow Fever, but found it would swell the book to an inconvenient size. It will make the first part of the second volume; the materials for which have been chiefly collected, and considerable portions of it written, so that the author hopes it may be committed to the press in about a year.

On the manner in which the work (when finished) will be received by the profession, he does not attempt to form a prediction; but has entire confidence in the justice of those for whom it is especially designed. He has, also, no reason to doubt, that the periodical press of the country, will treat him with equal justice; and he desires nothing more. If a second edition should be demanded, the errors which may be pointed out, would be corrected, and new facts and observations introduced: If the work prove a failure as it respects public favor, the author will not be without his reward; for he has found enjoyment in the labor of producing it; and, having confidence in its general accuracy, knows that it must stand as a great collection of facts; a picture of the etiological condition and the diseases, of a newly settled country, in the middle of the nineteenth century; with which future, and more gifted, medical historians, will compare the causes, phenomena, and treatment of the maladies which may then prevail.

Cincinnati, December 20, 1849. DAN. DRAKE, M. D.

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THE

PRINCIPAL DISEASES

OF THE

INTERIOR VALLEY OF NORTH AMERICA.

Book First.

GENERAL ETIOLOGY.

INTRODUCTION.

THERE are diseases which occur independently of all known external influences, which affect individuals of all races, and present in all cases substantially the same symptoms and lesions of structure; of which cancer, fungus hæmatodes, melanosis, wens, cataract, ossifications, apoplexy, and various chronic affections of the skin, may be cited as examples. There are others, depending on known and common causes to which man is exposed in all countries, climates, and states of society; such as inflammations from mechanical injuries, burns, or the ingestion of acrid poisons, which, respectively, present nearly the same characteristics, wherever or in whatever race they occur. Others, again, result from specific causes which are reproduced in the bodies of the sick, whereby they spread, with great uniformity of symptoms, to all who are exposed; such as small pox, cow pox, measles, and hooping cough. In reference to all these, and other diseases which might be mentioned, it may be said, that the observations made in one country are, in the main, equally applicable to every other. The maladies are the common scourge of our race; and the knowledge of their symptoms, lesions, and treatment, the common heritage of our profession.

On the other hand, there are diseases which scarcely ever occur but in certain climates, localities, or states of society; of which we may select for illustration, yellow fever, autumnal intermittent and remittent fever, plague, pneumonia, goitre and cretinism, gout, scurvy, and mania, most of which, moreover, in different countries, ages, and races, exhibit some variety of type, and demand some peculiarity of treatment. Here then is the foundation of local medical history and practice; a basis which does not support the whole nosology, and yet is broad enough for a large superstructure, whenever an extended region constitutes the field of inquiry.

That many physicians overrate the degree of variation from a common standard which the diseases of different countries present, I am quite convinced; but feel equally assured, that if the maladies of each country were studied and described, without a reference to those of any other, it would be found, if the state of medical science were equal in them, that the works thus produced would not be commutable, but that each would be better adapted, as a book of etiology, diagnosis, and practice, to the profession and people among which it was written, than to any other. *How much* better, would depend on the various identities and discrepancies which might exist between the countries thus compared. If their geological, hydrographical, topographical, climatic, social, and physiological conditions were nearly the same, of course their medical histories would be much alike; but if they differed widely in one or several of these conditions, a corresponding diversity would appear in the respective histories of all the diseases, which admit of modification from causes referable to those heads.

The work on which we are entering, is an attempt to present an account, etiological, symptomatical, and therapeutic, of the most important diseases of a particular portion of the earth; not of a state or political division, for it is indirectly, and to a very limited extent only, that civil divisions can originate varieties in the character of disease. Physical causes lie at the bottom of whatever differences the maladies of different portions of the earth may present; and hence the region which a medical historian selects, should have well-defined natural, and not merely conventional boundaries.

The INTERIOR VALLEY, or deeply depressed, intermontane plain of NORTH AMERICA, has been already announced, as the region to which this work relates. Great valleys have both alpine and marine borders, and the medical historian should comprehend them in his researches. Faithful to this duty, and adopting a hydrographical method, I have ascended our streams to their mountain sources, or descended them to the sea, at points exceedingly distant from each other. The vast extent of this field of inquiry would, at first view, seem to be a great disadvantage, but is, in fact, highly favorable to the development of results; as it enables us to trace a disease, in continuity, from its points of greatest prevalence, to its disappearance under new physical or moral and social conditions.

To these conditions I wish now to direct the attention of the reader. When they are subjected to a first analysis, we find them resolved into three principal groups. The first comprehends all that belong to the earth, considered in the composition and mechanical arrangement of its superficial strata, the qualities of its soil, and the amount, distribution, and quality of its waters: these are the telluric or geological influences. The second comprises all that belong to the atmosphere, in its mechanical action, sensible qualities, and adventitious impregnations: which make the climatic or meteorological influences. To the third belongs whatever appertains to society, considered in reference to national physiology, density of population, diet, drinks, clothing, occupations, amusements, intellectual cultivation, and moral improvement: in which are embraced the social and physiological influences.

It is not necessary to decide that all the agents capable of producing diseases not found in other countries, or of modifying those which are, can be referred to these heads; but they will certainly comprehend the majority, including the most important; and whatever remain, will fall under consideration with the particular diseases which they either occasion or modify.

In describing our topography, climate, and states of society, I might have noted the relative prevalence of many diseases; but such a course would have been attended with numerous embarrassments. I selected two, therefore, which, from universal observation, are known to have a most intimate connection, in their origin or prevalence, with soil and climate; and have very generally noted the degree of their occurrence, or their absence, in each locality; thus endeavoring to maintain in the mind of the reader, the connection which, in nature, exists between topography and etiology. He must not, however, forget that this connection is not limited to those diseases, but must expect that, in the study of many others, a reference to the topographical descriptions on which we are about to enter, will frequently be made.

As an introduction to the difficult task of topographical description, over so large a surface, I have attempted to prepare, as it were, a geographical back ground, fitted (to continue the metaphor) to bring out, more distinctly, the characteristics of each locality. Thus a comprehensive outline of the physical geography and hydrology of the whole region, precedes all local description; and in the unsettled portions of the valley, comprehends all that seemed necessary to our purpose. I have also sought to give the progressive topography a geological basis, a hydrographical guidance, and a climatic order, all of which, it will be seen, was in some degree practicable. Beginning with the shores of the Gulf of Mexico, and advancing north, we pass successively over all the geological formations of the valley, from the newest to the oldest. Again, commencing at the gulf, we start on a proper hydrographical base line, and by ascending the Mississippi, are guided in the same direction as before. Again, in starting from the gulf, below the twenty-third degree of north latitude, we get a tropical base line for our climates; and in advancing to the north, reach, progressively, higher latitudes, greater elevations, and further distances from the sea. Finally, while ascending the Mississippi, if we turn from it to the east or west, we constantly attain to a higher level and a dryer surface.

If we pass out of the valley of that river into the basin of the Great Lakes and the St. Lawrence, we find similar, though less striking, relations. Thus, in descending to the south, from the summit level beyond Lake Superior to the western end of Lake Erie, we pass regularly from older to newer geological formations — from a wetter to a dryer surface — from higher to lower levels; and when we turn from the extremity of the latter lake, and advance in the direction of the St. Lawrence, we pass from newer to older geological deposits, — from lower to higher latitudes, and from higher to lower elevations, until we reach the tides in that river. Lastly, if we pass over the dividing ridge between the waters of the southern and northern parts of the Valley, and descend the rivers which disembogue into the frozen seas of the north, we travel most of the way over primitive rocks, are constantly arriving in a higher latitude, and as constantly sinking to a lower level, until we reach the ocean.

It has been my aim to keep these various relations in view, and so to proceed with the descriptions, as to have no locality insulated, but each to follow some other in a natural sequence, and thus to arrange the whole into one topographical system.

With what degree of success this object has been accomplished, each reader will determine for himself; while all, I trust, will approve the method, and admit the inherent difficulties of its execution on so great a scale.

PART FIRST.

TOPOGRAPHICAL AND HYDROGRAPHICAL ETIOLOGY.

CHAPTER I.

GENERAL ANALYSIS.

SECTION I.

NATURAL BOUNDARIES, AREA, AND ASPECTS.

I. Natural Boundaries.—The Interior Valley of North America begins within the tropics, and terminates within the polar circle; traversing the continent from south to north, and passing through the entire northern, temperate zone. In the south it rests upon, and is deeply indented by, the Gulf of Mexico; in the north it bears a similar relation to the Polar Sea and Hudson Bay; the latter penetrating it so deeply, as to come within twenty-two degrees of latitude of the Gulf of Mexico. On the east its limits are the Appalachian Mountains, which extend from the thirty-third to the fifty-third degree of latitude, each end terminating in a low water shed. On the west, the immense chains of Rocky and Sea-side Mountains, beginning within the torrid zone and ending beyond the polar circle, seclude it from the Pacific Ocean. These mountain borders, as may be seen on the map (*Pl. I*), diverge from each other as they cross the continent, and thus the Valley regularly widens as it passes from south to north.

II. Area.—Of the area of this great intermontane region it is not easy to speak with much precision. To the south its latitudes vary from the eighteenth to the thirtieth parallels; in the north, from the fiftieth to the seventieth. In the south, its eastern margin is found near the eighty-first meridian; its western, in the one hundred and fifth; but in the fifty-third degree of latitude, it advances east to the fifty-sixth meridian, and west to the one hundred and sixteenth; finally, in the sixty-eighth parallel, its western margin is found in the one hundred and thirty-sixth degree of longitude.

If we assume eight millions of square miles as the area of North America, the Valley cannot be estimated at less than six millions, or three-fourths of the whole continental surface. Its northern half, however, is rendered nearly uninhabitable by the state of its surface and its climate; and, therefore, the portion which presents objects of immediate interest to the medical etiologist, does not exceed three millions of square miles, of which, as yet, not more than one-third has acquired even a sparse civilized population.

III. ASPECTS.—The Rocky Mountains, which, as we have seen, constitute the western boundary of the Great Valley, are a continuation of the Cordilleras of Mexico. Their course is nearly north west, to the twenty-eighth or thirtieth parallel; then north, to the forty-fourth or forty-fifth, and then north-north west to the seventieth, where they reach the Polar Sea. Their elevation, which becomes rather greater as we advance, varies from ten to fourteen thousand feet. They are composed of many chains, closely united by offsets. Their average distance from the coast of the Pacific Ocean, to which they lie nearly parallel, is about ten degrees of longitude. Very near that coast, however, there runs another chain, of narrower base, but equal or greater altitude, especially in the far north, where some of the peaks rise to the hight of fifteen or sixteen thousand feet. These mountains originate in the peninsula of California, near the tropic of cancer, and terminate about the sixtieth degree of north latitude. They are called, by Humboldt, the Californian Maritime Alps — by Fremont, the Sierra Nevada. Many of them are volcanic. The valley of the Oregon, or Columbia River, lies between this chain and the Rocky Mountains, and makes its way to the Pacific through the former, about the forty-sixth parallel.

The physician who would understand the true character of the climate of the Interior Valley, from south to north, cannot too strongly fix his attention on these lengthened and elevated mountain chains, which so effectually cut it off from the genial influences of the Pacific Ocean. In descending upon the plain, of which they constitute the western buttress, we find that they rise from five to six thousand feet above it. Beyond the fiftieth degree of north latitude, a chain of lakes approaches them, and a long river flows near their base into the Polar Sea. Below that parallel the lakes are distant; the rivers generally flow off at right angles from these mountain chains; and spurs and tracts of hill or high table land project from them, or are found insulated upon the plain, of which the most elevated and extensive are the following:

1. *The Sweetwater Mountains and Black Hills.*—Shooting out from the flanks of the Rocky Mountains, between the forty-second and forty-third parallels, the Sweetwater mountains bear to the east, from the one hundred and ninth to the one hundred and sixth meridian; when, receiving the name of Black Hills, they stretch off to the north east, and terminate about the forty-sixth parallel. Their altitude ranges from four to eight thousand feet.

2. *The Llano Estacado*, or *Staked Plain*, lies south of the last, in mean latitude thirty-four degrees north, and mean longitude one hundred and two degrees west. It may be regarded as an extensive tract of table land, the

general surface of which is, by estimate, two thousand feet above the streams which flow around its steep acclivities.*

3. *The Ozark Mountains.*—They commence not far from the eastern margin of the Llano Estacado, of which they ought, perhaps, to be regarded as a rugged continuation; and, bearing north east, terminate about the thirty-eighth degree of north latitude and the ninety-first of west longitude, near the Missouri river. Their breadth is not great, and their elevation (as yet undetermined) is, perhaps, not above that of the Llano Estacado.

4. *The Coteau des prairies*, a table land rising to the hight of eighteen hundred and even two thousand feet, and distributing the rivers which originate upon it, between the Mississippi and Missouri. Its head or northern extremity is in latitude forty-six degrees north.

Such are the chief protuberances on the great inclined plain, which descends from the eastern base of the Rocky Mountains, to the synclinal axis, or trough, of the Valley.

Let us pass to a similar survey of the eastern side of the Valley.

As we have already seen, the Appalachian Mountains limit the Valley plain to the east. In length and breadth they are but little more than one third as great as the Rocky Mountains,—in altitude, about one-fourth; though a few summits, both in the south and north, rise to more than one-third of the elevation of the highest points of the western chain. Their general course is north east, and mostly parallel to the western shore of the Atlantic Ocean. They are composed of interrupted, but nearly parallel, ridges; which, between the latitudes of forty-two and forty-six degrees, are cut through in two places to the level of the plain of which they are the eastern rampart, and in one place to the level of the sea. On their western side, they are flanked by an elevated belt of hills, from the latitude of forty-two to thirty-three degrees; where, in North Alabama, it turns to the west, and approaches the Mississippi in the direction of the Ozark Mountains. The plain, which stretches from the Appalachian chain to the trough of the Great Valley, is much narrower than that of the opposite side; and, although in general more rugged, presents no hills or table lands approaching in hight the Ozark Mountains, the Llano Estacado, or the Black Hills. That which constitutes the greatest difference in the aspect of this, compared with the last, is its interruption above the forty-second degree of latitude, by the Great Lakes, and the formation of the St. Lawrence, which makes its way through the Appalachian chain:—for this there is no parallel on the western side.

The northern part of the interior of the continent presents much less of a valley aspect. The Rocky Mountains continue to the Polar Sea, near the seventieth degree of latitude; but the Appalachian range expires before it

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* Commerce of the Prairies. By Josiah Gregg, now M. D.

reaches the Labrador coast of the Pacific Ocean, about the fifty-third parallel. Thus it may be said, that a great flat stretches across the northern part of the continent from the Rocky Mountains, which is repeatedly indented by the sea, from the mouth of McKenzie River, near the termination of the Rocky Mountains, round to the coast of Labrador, resting on the Gulf of St. Lawrence.

It will be seen from these statements, that the eastern side of the Interior Valley is much less protected from the influences of the Atlantic Ocean, than the western is from those of the Pacific.

SECTION II.

HYDROGRAPHICAL SYSTEM.

We must now take a brief preliminary view of the hydrology of the region, the boundaries, area, and aspects of which have been comprehensively sketched.

I. Seas.—Penetrating deeply into the southern and northern sides of the Valley, the Gulf of Mexico and Hudson Bay (two mediterranean seas) exert a decided influence on its physical character; for they give a great extent of inland sea coast; while they, respectively, draw to themselves, from opposite directions, many large rivers which originate near each other in the central parts of the Valley, and thus establish a sort of water axis through the continent, nearly in the direction of the meridian.

II. Lakes.—While the south-western third part of the Valley is nearly destitute of lakes, the other parts present them in countless numbers. The smaller appear to be dispersed without any kind of order; but the larger, present a series, or system, which merits attention. Commencing with Great Bear Lake, a large sheet of water in the north-west corner of the Valley, near the Arctic Circle, west longitude one hundred and twenty-seven degrees, the lacustrine chain stretches toward the south east. To that lake at first succeeds a series of smaller ones, with intervening straits, which connect them with Great Slave Lake. After this follows, in the same range, Lake Athabasca, then the smaller lakes Wollaston and Deer, then Lake Winnipeg, of larger size, and near it the well-known Lake of the Woods, in the forty-ninth degree of north latitude and ninety-fifth west longitude, with which are connected, by the river Winnipeg, a considerable series of smaller lakes. The chain now suddenly expands into great dimensions; the first link, Lake Superior, being the largest on the continent. To this succeed Huron and Michigan, and then Erie, which approaches the flanks of the Appalachian Mountains, in the latitude of forty-one degrees north, and the longitude of eighty degrees west. With Lake Erie the axis changes from south east to north east, and is continued in that direction, parallel to the mountains, through Lake Ontario, until it reaches the St. Lawrence; which has several lacustrine expansions, and is connected laterally with Champlain and many smaller lakes. This is, perhaps, the longest series of lakes which the world contains. The superfluous waters of those which lie farthest north, as Bear, Slave, and Athabasca, flow into the Arctic Sea. Further south, the middle portions (of which Lake Winnipeg is chief) pour their waters, through Churchill and Nelson Rivers, into Hudson Bay. The eastern, from Lake Superior to Lake Champlain, flow into the Gulf of St. Lawrence. For three fourths of its length, that is, from Great Bear Lake to Lake Michigan, the series runs almost parallel to the Rocky Mountains; diverging, however, to the north at an angle of a few degrees; while the last fourth part of the chain lies parallel with the northern Appalachian Mountains. About the ninety-seventh degree of west longitude, in Lake Winnipeg, the lacustrine axis intersects the river axis between Hudson Bay and the Gulf of Mexico. To the north east of this extended chain, on every side of Hudson Bay, the surface abounds in lakes, but they are generally small and without any known systematic distribution.

III. Rivers.—The invention of steamboats has given a new impulse to settlements on the banks of rivers. There we find the largest cities; and between them, where the banks and bottom lands are sufficiently elevated, we have the densest rural population. Thus our rivers have become objects of paramount interest to the medical etiologist; and without a full consideration of them, but little can be said on the endemic febrile diseases of the country. Reserving all details for subsequent chapters, I propose, in this preliminary and perspective view, to present a rapid, yet systematic, enumeration of the most important. For this the way has been prepared, by the general survey of our mountains, elevated plains, seas, and lakes, with some of which every considerable river, either at one or the other of its extremities, is connected. In calling them over, it will be advantageous to do it by the centers or axes in which they originate. Of these centers, some are entirely within the Valley— others, among the mountains which constitute its lateral boundaries. I shall begin with the former.

1. *Valley Hydrographical Axes and Centers.*

A. Of these centers the most important is the region which lies west of Lake Superior, in mean latitude forty-seven degrees north, and mean longitude ninety-five degrees west. Its position, as may be seen on the map (*Pl. I.*), is near the superficial center of the continent. Its average elevation is about fifteen hundred feet above the sea, its greatest, less than two thousand, and still it sends off vast rivers, in three different directions.

a. The *Mississippi.* Rising under its own proper name, and also by its great tributary, the *St. Peter's*, or *Minisotah*, this river descends to the south, through eighteen degrees of latitude, and after flowing three thousand miles, chiefly in the central trough of the Great Valley, pours its waters into the Gulf of Mexico, under the twenty-ninth parallel of latitude.

b. The *St. Lawrence* begins, under the name of St. Louis, in the same region with the Mississippi. By a rapid descent, it throws its waters into the west end of Lake Superior, to issue from the opposite extremity under the name of *St. Mary's.* Lost in Lake Huron, it reäppears under the name of *St. Clair River*, which opens into the lake of the same name; whence it emerges, with a new designation, the *Detroit*, to be absorbed by Lake Erie. Out of the eastern extremity of this lake, it emerges as the *Niagara River*, to precipitate itself, by the celebrated Falls, into Lake Ontario; from which, under the appellation of St. Lawrence, it flows north eastwardly into the gulf which bears its name, about the forty-eighth degree of north latitude, and the sixty-fourth of west longitude, having a length of about two thousand miles.

c. Red River, of the North. The sources of this river lie on the same plateau as those of the two just described; whence it flows directly north, and discharges its waters into Lake Winnipeg, from which they issue under the names of *Nelson* and *Hayes'* Rivers, to be poured into Hudson Bay, in latitude fifty-seven degrees north. Its length, under different names, is about fifteen hundred miles. The bed of this river lies nearly in the same meridian with that of the Mississippi, and they flow, though in opposite directions, through the longitudinal trough of the great Interior Valley.

B. West of Lake Michigan, in the mean latitude of forty-five degrees, and between the longitudes of eighty-nine and ninety-two degrees west, there is a hydrographical axis, which, although entirely subordinate to the preceding, deserves to be noticed. Its general course is south east and north west. To the north, it throws into Lake Superior a few short and unimportant rivers, — to the east, it originates *Fox River*, which, passing through Lake Winnebago, enters Lake Michigan, by Green Bay. But the contributions of this axis to the Mississippi are much greater than to the Lakes. Thus, beginning in the north, we have the *St. Croix*, *Chippewa*, *Sappah* or *Black*, *Wisconsin*, and *Rock Rivers*, which flow to the south west, and enter the Mississippi at something like equal distances from each other,— the mouths of the first and last being more than four hundred miles apart. Of the whole, the Wisconsin is the largest, and constitutes the principal river of the state which bears its name. This axis, the mean elevation of which may be about one thousand feet above the sea, abounds in small lakes. Its northern and eastern margins approach very near to Superior and Michigan; and hence the small number and short course of the rivers of those sides, compared with the opposite.

C. The axis last described lies on the western side of Lake Michigan.

On the opposite side of that lake, through the center of the southern part of the state of Michigan, there is another axis, elevated from five to eleven hundred feet, from which the *St. Joseph's*, *Kalamazoo*, and *Grand Rivers* descend westwardly to Lake Michigan; the *Saginaw*, northerly to Lake Huron; and the *Huron, Raisin*, and part of the *Maumee*, eastwardly to Lake Erie.

D. In the states of Indiana and Ohio, south and south west of Lake Erie, there is a hydrographical axis, which, although, like the latter, greatly inferior to the first, deserves to be noticed. Beginning near the south-western extremity of Lake Michigan, it gradually rises on passing out of Indiana to the east, and before it has reached the western boundary of Pennsylvania, attains an elevation of eleven or twelve hundred feet. The descent from this ridge to Lake Erie is much more rapid, because shorter, than that in the opposite direction. The western part of this axis gives origin to the greatest number of rivers, although its altitude is least. Their sources are in the mean latitude of forty degrees north, and longitude of eighty-five degrees west. They consist of the following:

a. The *Kankakee*, or true head of the Illinois, which, originating in the state of Indiana, flows nearly west, at a short distance from Lake Michigan, into the state of Illinois, where it takes the name of that state, and bearing to the south west, enters the Mississippi River above the mouth of the Missouri, being the principal river of the state.

b. The *St. Joseph's*, which, originating partly in the north-east corner of Indiana, and partly in the south-west corner of the state of Michigan, flows to the north west to pour its waters into the lake of that name.

c. The *Wabash*, which, beginning in the western edge of Ohio, runs westwardly into Indiana; and, at length, turning to the south west and south, crosses the state, and enters the Ohio river, one hundred and thirty miles from its mouth. This is the great river of Indiana, and the largest tributary of the north side of the Ohio.

d. The *Maumee*. Interlocking in its origins with the Wabash, in the states of Indiana and Ohio, this river flows in an opposite direction from the last, that is to the north east, and enters the west end of Lake Erie, through Maumee Bay — being much shorter than the Wabash.

e. The *Great Miami*, whose sources mingle with those of the last two. It descends nearly south to join the Ohio River near Lawrenceburgh, at the boundary line between Ohio and Indiana, twenty miles below Cincinnati.

f. The *Sandusky*, which, originating further east, flows nearly north and expands into the bay of the same name, which opens into Lake Erie, near the city of Sandusky.

g. The *Scioto*, a counterpart of the last, which interlocks in origin with it, and flowing nearly south by Columbus, the capital of Ohio, reaches the Ohio River at Portsmouth. This is the longest river of the state.

h. The *Cuyahoga*, which rises in the "Western Reserve," and pursues at first a western, and then a northern course to Lake Erie, at Cleveland.

i. The *Muskingum*, again the counterpart of the Cuyahoga, with which some of its eastern sources interlock, bends considerably to the west, then turns eastwardly, and finally joins the Ohio at Marietta, nearly in the longitude of Cleveland.

j. *Grand River*, the origin of which is in the same tract with that of the Cuyahoga, takes a more direct, northern course to the lake, which it enters near Painesville, thirty miles further east.

k. *Big Beaver River*, which, under the more dignified names of *Mahoning* and *Shenango*, its elementary branches, originates with the last two rivers, but flows south south east, to unite with the Ohio at the town of Beaver, thirty miles below Pittsburgh.

Besides these there are several smaller rivers: as, on the north side of the summit level, *Portage*, between Maumee and Sandusky, and *Huron*, *Vermillion* and *Black*, between the latter and Cuyahoga. On the south side, the *Little Miami*, between the Great Miami and Scioto, and *Hocking*, between the latter and Muskingum.

Thus, as we see, this is an important hydrographical axis, giving origin to most of the rivers which flow through Indiana and Ohio, while it performs the more important function of separating the waters of the Gulf of Mexico from those of the St. Lawrence, through eight degrees of longitude, or more than four hundred miles. This axis, depressed from four hundred to eight hundred feet below the hydrographical center west of Lake Superior, is, like it, a plain or table, with many ponds or small lakes, and numerous swamps.

E. Far to the south, but still on the eastern side of the Mississippi, we have, in the high lands of the states of Alabama and Mississippi, properly a low spur of the Appalachian chain, a fifth hydrographical axis, from which short tributaries of Tennessee River descend to the north, and several more considerable rivers flow off to the south. These are the *Yazoo* and *Big Black*, which join the Mississippi, and the *Tombeckbee* and *Tuscaloosa* that unite with the *Alabama* to form the *Mobile*, which disembogues into the Gulf of Mexico.

Such are the interior hydrogaphical centers on the eastern side of the Mississippi. We must now pass to the western, and begin in the south.

F. In the northern part of the state of Texas, far in the south west of the Valley, there is a hilly axis, which throws out the *Sabine*, *Trinity*, *Brazos*, *Colorado*, and *Nueces*, which flow into the Gulf of Mexico.

G. Ascending northwardly we come, between the thirty-sixth and thirty-eighth degrees of latitude, to another center — the Ozark mountains. Besides certain branches of the *Arkansas River*, and of the *Great Osage* — a tributary of the Missouri — the *Gasconade*, another affluent of that river, and the *Maramac*, *St. Francis*, *White River*, and *Washita*, tributaries of the Mississippi, have their origin, in whole or in part, in the Ozarks.

H. Advancing to the north west we come to the Black Hills, in the great bend of the Missouri River, which send all their streams into that river on the east, or into its large tributary, the Yellow Stone, on the west.

We have now passed over all the important hydrographical axes and centers of the southern part of the Great Valley, and a few paragraphs will suffice for those of the north, lying beyond the great Lakes and the sources of the Mississippi.

I. The water table between Hudson Bay and the Lakes and St. Lawrence, sends forth several rivers to the former, or into Lake Winnipeg, of which the *Abbitibbe* and *Rupert* may be mentioned. It also gives origin to the *Ottawa*, *St. Maurice*, *St. Anne*, and *Saguenay*, important tributaries of the St. Lawrence, which of course flow in an opposite direction.

J. Finally, far to the north west, in the sterile regions east of Great Bear Lake, there is a center whence the *Yellow Knife River* flows into an arm of Great Slave Lake, and the *Copper Mine* and *Thlew-ee-chok*, or *Back's River*, into the Polar Sea.

2. *Mountain Border Axes and Centers.*

By a natural transition, we ascend from this part of the Valley to the most distant of the mountain axes in the north west.

A. The Northern Rocky Mountain Axis. In the magnitude of the rivers which it originates, this is the greatest axis on the continent. Its mean latitude is fifty-one or fifty-two degrees north west, its average longitude one hundred and fifteen. Its general elevation is ten or twelve thousand feet; but it embraces Mount Brown and Mount Hooker, which rise much higher. Its rivers may be divided into those which flow into and through the Valley, and those which make their way, in the opposite direction, to the Pacific Ocean. We begin with the former.

a. Mackenzie River, of which the most northern branch — latitude fifty-nine degrees — is the *Liards* or *Turn Again;* then the *Unjigah* or *Peace River*; lastly, the *Athabasca*. It flows through most of its course near the base of the mountains, and enters the Polar Sea, having its *embouchure* in the north-west corner of the Valley, at a higher latitude than any other river of the continent.

b. The north and south branches of the *Saskatchawan*, which flow eastwardly to Hudson Bay.

c. The *Missouri*, which, by its northern branch, the *Maria*, has a connection with this axis.

d. Frazer River, which flows southerly, and discharges its waters into the Pacific Ocean through Vancouver Sound, in north latitude forty-nine degrees.

e. The *North Fork of Oregon or Columbia River*, which, after uniting with the *South Fork*, reaches the same ocean, a little above the forty-sixth parallel, near the one hundred and twenty-fourth meridian.

B. The Southern Rocky Mountain Axis. The mean latitude and longitude of this axis may be taken at forty-one degrees north, and one hundred and seven degrees west. Its average elevation is eleven thousand feet. On the east or valley side, it sends down:

a. The southern rivulets of *Big Horn*, an important branch of the *Yellow Stone*, which, flowing north east through six degrees of latitude, unites with the Misssouri under the forty-ninth parallel.

b. The *Nebraska* or *Platte*, which, flowing nearly east, traverses the great inclined plain of the Rocky Mountains, and empties into the Missouri River, below the Yellow Stone, in the forty-first degree of latitude.

c. The *Kansas*, which flows nearly east, to unite with the Missouri below the Platte, precisely at the western boundary of the state of Missouri.

d. The *Arkansas*, which traverses the same plain, at first to the east, and then to the south east, until it joins the Mississippi, near the thirty-fourth degree of latitude, thirteen hundred miles below the Platte, and more than two thousand below the Yellow Stone.

e. Red River, which has less connection with the axis than the last, and after flowing eastwardly for several hundred miles, turns to the south-south east, to discharge its waters into the Mississippi, in north latitude thirty-one degrees, being the last tributary of that great river.

f. The *Rio del Norte*, which descends to the south, then turns to the south east, and discharges its waters into the Gulf of Mexico, in latitude twenty-five degrees.

As the Missouri, after receiving the Yellow Stone, Platte, and Kansas, unites with the Mississippi, it follows that all the eastern rivers originated by this hydrographical axis, except the Rio del Norte, discharge their waters into the gulf through that great river.

On the western side of the Rocky Mountains, the center we are now considering, originates:

g. The southern fork of the Columbia, known under the name of *Lewis River,* which flows nearly north west to join the Northern Branch, or *Clarke River,* at Wallah Wallah, and then proceeds to the Pacific Ocean.

h. The *Rio Colorado,* which, pursuing a south-westerly course, enters the northern extremity of the Gulf of California, about the thirty-second degree of north latitude.

Let us now turn to the eastern or Appalachian mountain chain, beginning in the north. The rivers which it originates are smaller, and the hydrographical centers less obvious, but still recognizable.

A. The elevated White and Green Mountain axis, sends down to the north the *Chaudiere, Nicollet, Yamaska, St. Francis,* and many smaller rivers to the St. Lawrence; to the west, they pour several streams into Lake Champlain, whence they make their way through the *Richelieu* to the same great river; to the south, they give origin to the *St. John's, Penobscot, Kennebec,* and *Connecticut,* which flow into the Atlantic Ocean.

B. The Adirondack center, lying between Lake Ontario and Lake Champlain, in mean latitude and longitude, forty-four and seventy-four degrees, has an average elevation at four thousand five hundred feet, and originates a number of rivers, which radiate in all directions.

a. To the east, it sends down the *Saranac,* the *Au Sable,* and some smaller streams which empty into Lake Champlain.

b. To the north, the *Salmon, St. Regis, Racket, La Grasse,* and *Oswegatchie,* tributaries of the St. Lawrence.

c. To the west, *Black River,* of Lake Ontario.

d. To the south, *West Canada River,* in which are the celebrated Trenton Falls, by which it descends to the *Mohawk.* Lastly,

e. The *Hudson,* which flowing also to the south, enters the Atlantic Ocean at New York.

The area of this center is small, and the rivers which it originates, though numerous and abounding in water, are short.

C. Further west and south, in the mean latitude of forty-two degrees and longitude of seventy-eight degrees, lying in the states of New York and Pennsylvania, we have another Appalachian center, the average hight of which is about eighteen hundred feet. The rivers which flow from it are as follows:

a. To the north, the *Gennesee,* or principal river of Western New York, which discharges its waters into the middle of the south side of Lake Ontario, after traversing less than a degree and a half of latitude.

b. The *Oswego*, which likewise enters Lake Ontario, and discharges the water of many long, narrow lakes, which are fed by streams which originate in this center.

c. To the east we have many of the western branches of the *Susquehannah*, which, pursuing nearly a south-easterly course, enters the head of Chesapeake Bay.

d. From the south-western declivity of this center, all the head waters of the *Alleghany* descend to form that river, which, pursuing a southerly course to Pittsburgh, joins the *Monongahela;* when the united stream takes the name of *Ohio*, and flows in a west-south-west course to the Mississippi.

D. Between the thirty-eighth and thirty-ninth degrees of north latitude, and seventy-ninth and eightieth of west longitude, in the state of Virginia, we have a third hydrographical axis, in which are found the celebrated mineral springs of that state. Its average levels may be given at two thousand feet. To the east it throws off—

a. The *Potomac*, which, after bending to the north, turns south easterly, and enters Chesapeake Bay.

b. *James River*, lying south of the last, running more directly east, and entering the same bay near its junction with the Atlantic Ocean.

c. To the north, this center sends out the *Monongahela*, which flows in that direction, to unite, at Pittsburg, with its larger and longer fellow, the Alleghany, in forming the Ohio river.

d. From the same center, *Greenbrier River* passes off to the south west, and descends, by a comparatively short course, into the *Kanawha River*, and thence into the Ohio.

E. The last hydrographical axis in this chain of mountains is found chiefly in the state of North Carolina; but it comprehends, also, the south-west angle of Virginia, the northern parts of South Carolina and Georgia, and the eastern margin of Tennessee. Its mean latitude is thirty-six degrees — its mean longitude, eighty-two degrees. Its mean elevation is greater than either of the last two, being not less than three thousand feet, with some peaks much higher.

From the eastern and southern margin, it throws into the Atlantic Ocean —

a. The *Roanoke*, or at least one of its largest branches, which enters Albemarle Sound.

b. *Cape Fear River*, wholly within the state of North Carolina, which reaches the Atlantic Ocean by a south-east course.

c. The *Yadkin*, which, on entering South Carolina, takes on the name of

Pedee, and continuing in a direction east of south, discharges its waters into the Atlantic.

d. The *Catawba*, or *Wateree*, the *Broad River*, and the *Saluda River*, which converge into a common trough that bears the name of *Santee*, and by a south-easterly course, arrives at the Atlantic.

e. The *Savannah*, which, for most of its course serves, as the dividing line between South Carolina and Georgia. It holds a direct, and nearly south-east direction to the Atlantic Ocean.

Let us now turn to the interior, and enumerate the most important rivers which flow over it, from this axis.

f. The *Kenawha River.* To the north this summit level sends off the Kenawha, which for some distance bears the name of *New River.* Its course is first north east, and then north; so that it actually passes through the edge of the hydrographical center last described; after which it bends to the north west, to unite with the Ohio River, at Point Pleasant, two hundred and seventy four miles below Pittsburgh, about the thirty-ninth degree of latitude, and nearly in the longitude of its most distant sources. Its length is greater than that of either of the rivers just enumerated.

g. The *Big Sandy River*, the head springs of which are in the northern brow of this center, whence they descend to the north, and uniting, flow into the Ohio, about sixty miles below the Kenawha.

h. The *Kentucky River*, which flows in a north-west course from the same margin, and joins the Ohio, at Carrolton, between Cincinnati and Louisville.

i. The *Cumberland River*, whose sources, like those of the last two, are found in the north-west flanks of the same mountain center. Its course is at first west, through the south-east corner of Kentucky, then south west into Tennessee, then west, and finally north north west, across the state from which it had departed, to the Ohio River, at Smithland, fifty-six miles from the junction of that river with the Mississippi.

j. The *Tennessee River.* The origin of this river is largely from the hydrographical center we are now studying. The main trunk, which bears the name just mentioned, is composed of the *Clinch*, *Holston*, *French Broad*, and *Tennessee* proper. The Holston connects itself most intimately with the central portions of the summit level, where it interlocks with the sources of the Kenawha. The Tennessee, constituted by the union of these mountain streams, descends to the south west, through the eastern end of the state which bears its name; then passing within sight of the north-west corner of Georgia, and dipping into North Alabama, as low as the latitude of thirty-four degrees thirty minutes, it wheels to the north, and traversing the states of Tennessee and Kentucky, in the meridian of eighty-eight degrees west, joins the Ohio, of which it is the largest tributary, at Paducah, forty-five miles from the Mississippi. This junction is six hundred and sixty miles

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below that of the Kenawha, while the head rivulets of the two rivers are in the same locality.

k. Chattahoochee River. Its sources, which interlock with those of the Tennessee, are found chiefly in the state of Georgia, and the south-west corner of North Carolina. At first its course is south west, but at length changing to the south, and becoming a boundary line between Georgia and Alabama, it traverses middle Florida, and reaches the Gulf of Mexico, through Appalachicola Bay, below the thirtieth degree of latitude, and a little west of the eighty-fifth degree of west longitude.

l. The *Alabama River.* About the latitude of thirty-five degrees, and longitude of eighty-four degrees, that is, from the western outliers of this hydrographical axis, the Alabama, under the name of *Coosawattee*, afterward *Coosa*, has its origin in the northern part of Georgia. Entering the state of Alabama, near the north-east corner, it holds a south-south-west course to the Gulf of Mexico, near the south-east corner of the state; having been joined by the *Tullapoosa*, whose sources are a little south of its own.

Such are the principal rivers which arise, in whole or in part, in this great hydrographical axis, which constitutes the southern extremity of the Appalachian chain. Subordinate to these, however, there are several others which originate in the outliers and hill lands that flank the mountain platform. On the Atlantic side, they are, the *Cape Fear*, *Pedee*, and *Alatamaha*, of the Carolinas and Georgia. On the continental or valley side, the *Guyandotte*, in Virginia, and *Licking* and *Green Rivers*, in Kentucky, which discharge their waters into the Ohio.

The radiation from this axis extends round three fourths of a circle, that is, from the east, by the south and west, to the north; and the states traversed by the rivers which thence flow off are, Virginia, in its south-western portions, the Carolinas and Georgia, a small part of Florida, the larger portion of Alabama, and nearly the whole of Tennessee and Kentucky.

To the seventeen preceding valley and mountain hydrographical axes, nearly all the rivers of the continent may be referred. In their origins, however, they are not actually limited to the centers and axes with which they have their chief connection. Thus, the portions of mountain which lie between the five Appalachian centers just described, act as water sheds between the Atlantic plain and the Interior Valley; the whole range of the Rocky Mountains throws down streams into the heart of the continent, and also into the Pacific Ocean, yet they chiefly flow from the two portions of that chain which have been indicated. Still further, within the Valley, a water shed everywhere divides the streams of the north from those of the south; and yet, the centers and axes west of Lakes Superior and Michigan, and south of Lake Erie, send out nearly all the rivers which have their origin *within* the Valley.

SECTION III.

ALTITUDES AND CONFIGURATION.

It has been already intimated that the interior of the continent is traversed by a deep, winding, longitudinal depression, constituting a synclinal axis, which extends from the Gulf of Mexico to Hudson Bay. The Mississippi is found in this trough, through two thousand one hundred and ninety-two miles, and nearly sixteen degrees of latitude; that is, from the gulf, in latitude twenty-nine degrees north, to the mouth of St. Peter's River, in north latitude forty-four degrees fifty-two minutes. Here the axis makes a *detour* to the west, and incloses the latter river for four hundred and thirteen miles, to the upper end of Big Stone Lake,* into which the St. Peter's, having its origin in the adjacent *Coteau des prairies*, on the west, discharges its waters. Within three miles of this point, to the north, is the southern end of Lake Traverse. The ground between them is low, and when the St. Peter's is swollen, it sometimes sends a portion of its waters into this lake, so that canoes have passed from one to the other.† From the other extremity of Lake Traverse, Swan, or Sioux Creek flows to the north, and unites with Red River, which, having descended from the highlands to the east, now occupies the synclinal axis to Lake Winnipeg, in north latitude fifty degrees twenty minutes. From the north end of the latter lake, in latitude fifty-three degrees forty-two minutes, to Hudson Bay, in latitude fifty-seven degrees, the axis embraces Nelson River. Having traced it to the sea, let us return to the summit level or culminating line, between Big Stone and Traverse Lakes. Its distance from the Gulf of Mexico, following the sinnosities of the trough, is two thousand six hundred miles; its longitude ninety-six degrees thirty-four minutes west; its latitude forty-five degrees thirty-five minutes, or sixteen degrees thirty minutes from that of the *embouchure* of the Mississippi. Its altitude, Colonel Long assures me, cannot exceed nine hundred and seventy-five feet, if Mr. Nicollet be correct in assigning nine hundred and sixty-six feet as the elevation of Big Stone Lake. This gives a rise from the Gulf of Mexico of nearly twelve inches for every minute of latitude; and of four inches and a half for every mile, following the course of the river.

As the distance from this line of culmination to Hudson Bay is but twelve degrees thirty minutes of latitude, and the long level of Lake Winnipeg intervenes, it follows that the descent of the trough to the north is under a different law from that to the south. To Lake Winnipeg, now estimated by Colonel Long at the elevation of seven hundred and fifty feet, the fall is gradual and moderate; from that lake to Hudson Bay, precipitous.

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* Nicollet. Hydrographical basin of the Upper Mississippi, 1841.

† Narrative of an Expedition to the source of the St. Peter's River, under the command of Stephen H. Long, Major U. S. T. E. Compiled by N. H. Keating, 1823.

A projection or profile of this water curve may be seen in *Pl. II*, *Fig*. 1. Its northern extremity is three degrees thirty minutes west of its southern, the longitude of the latter being eighty-nine degrees six minutes west, that of the former ninety-two degrees thirty-six minutes; but at the summit level, as we have just seen, it is ninety-six degrees thirty-four minutes, and at the efflux of Nelson River from Lake Winnipeg, ninety-eight degrees, or nine degrees west of the mouth of the Mississippi.

A wide and deep current from the north, must have excavated this trough across the continent, and Lake Traverse and Big Stone Lake, are but hollows or chasms, left filled with water when that river ceased to flow. They are long, narrow, serpentine, and lie in the course of the obsolete river. They resemble the pools of a wet-weather stream, during a drought, or, more exactly, the crescent lakes of the lower Mississippi, which, as we shall hereafter see, were once portions of its ancient channel.

The width of these lakes is from one to two miles, and the immediate valley in which they lie but two or three times as much; then comes a rise of fifty or one hundred feet, with a gradual ascent beyond, to the elevation of one thousand eight hundred or two thousand feet, on the *Coteau des prairies* to the west, and another nearly as high, to the east, on which the Mississippi originates.

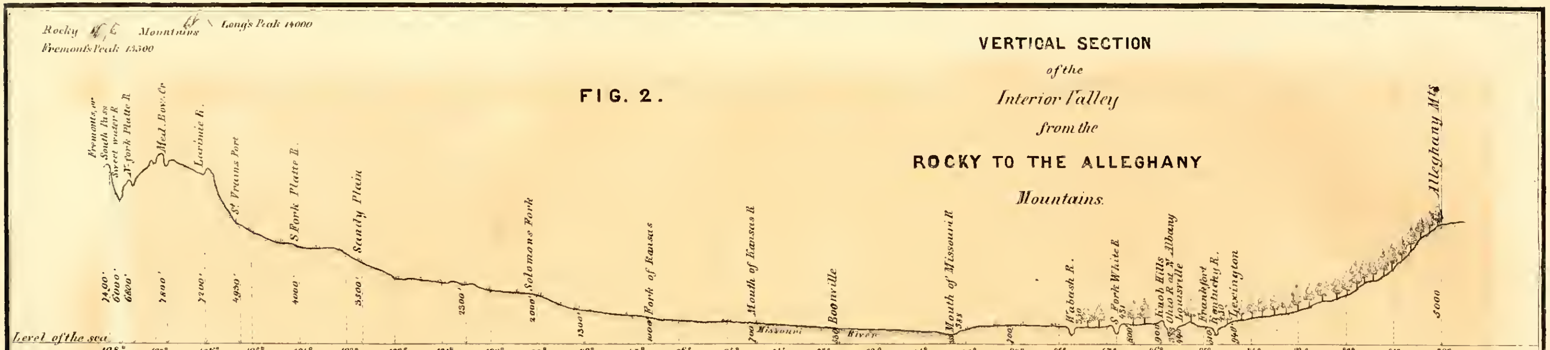
Such is the great continental aqueduct, which, from the junction of Red River with the Mississippi, in the state of Louisiana, under the thirty-first parallel, to the Saskatchawan, which unites with Lake Winnipeg and Nelson River about the fifty-fourth degree, receives and transmits, to the seas of the south and the north, all the superfluous waters which fall to the west of the trough, as far as the crests of the Rocky Mountains.

As this long synclinal axis runs nearly parallel to the mountain ranges, the inclined plain which lies between them is an irregular parallelogram. Its general aspect is to the east, but as it advances from the mountains, one portion inclines to the south, and another to the north. The line of this culmination leaves the Rocky Mountains about the forty-eighth or forty-ninth degree of north latitude; and advancing a little south of east, reaches Lake Superior, which is, as it were, set into its eastern extremity. On its way it is cut through by the trough or synclinal axis which has been described.

Let us turn to the region east of that axis. Measured from south to north, its length is nearly as great as that of the western plain, but its breadth far less, and very unequal in different latitudes. Below the latitude of thirty-four degrees it is narrow; it then suddenly spreads out to its greatest width, having for its eastern limits the spines of the Appalachian Mountains, from North Carolina to Pennsylvania; when, about the latitude of forty-one degrees north, its breadth is reduced nearly two thirds, and so continues to Hudson Bay. Through this plain there is also a culminating ridge, which extends from the mountains toward the central water axis.

No. 11.

FIG. 2.

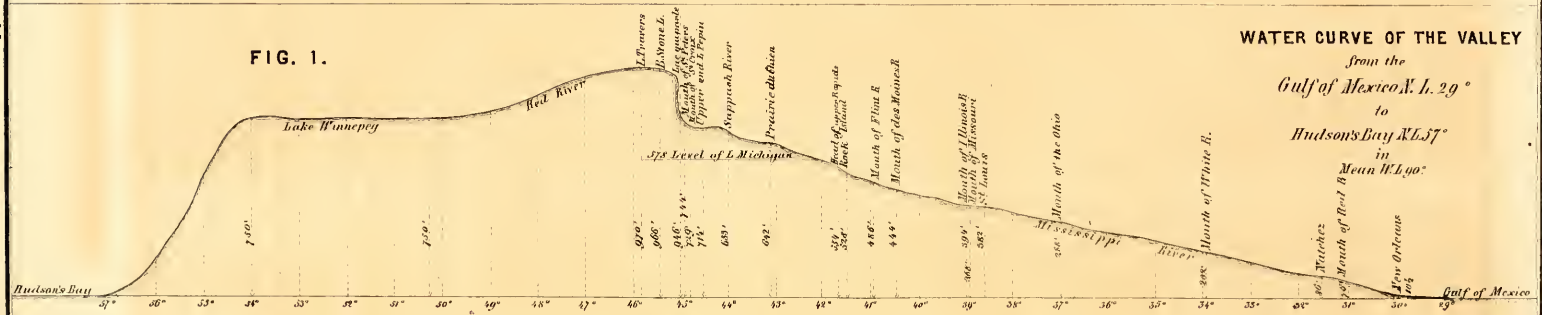


VERTICAL SECTION of the *Interior Valley from the* ROCKY TO THE ALLEGHANY *Mountains.*

Horizontal Scale 4° to an Inch

Vertical Scale 8000 ft. to an Inch.

FIG. 1.



WATER CURVE OF THE VALLEY *from the Gulf of Mexico N. L. 29° to Hudson's Bay N.L.57° in Mean W.L.90°*

Horizontal Scale - 4° to an Inch

Vertical Scale - 800 ft to an Inch.

By direction of D. Drake M.D. — *Face p. 20* — *C. A. Fuller U.S.C. Engr. del.*

From the southern side of this elevation, the waters ultimately reach the Gulf of Mexico, through the Mississippi; from the northern they fall into the Lakes and the St. Lawrence, and reach the Atlantic Ocean to the north east.

Here, then, is a new and distinct hydrological system — another synclinal axis, somewhat at right angles to that which has been delineated, and confined to the middle portion of the eastern plain. It begins with Lake Superior, and ends with the Gulf of St. Lawrence. In times past it had extensive water communications with the last, by several rivers, but especially the Illinois, which originates around the southern extremity of Lake Michigan, and flows to the Mississippi through a depression in the intervening barrier; which is so deep, that in times of flood, canoes have passed from one trough or synclinal axis into the other.

It results, from what has been said on the deep cuts which traverse the Interior Valley, that two voyagers might start from the Gulf of Mexico, in the latitude of twenty-nine degrees north; and ascending the Mississippi to the mouth of the Illinois river, one of them might take the course of that stream; pass into the Lakes, over an elevation of six hundred feet; descend the St. Lawrence; and make his exit into the Atlantic Ocean, upon the fishing banks of Newfoundland; twenty degrees north and thirty degrees east of his place of departure. The other, continuing up the Mississippi and over the Lake Traverse summit level, at the hight of nine hundred and seventy five feet, would descend into Hudson Bay; whence he might pass into the polar seas, amid perpetual ices; after having traversed more than forty degrees of latitude.

Let us develop still further the relative altitudes and configuration of the intermontane plain, through which such voyages might be performed, by supposing curves, like those in *Pl. II, Fig.* 1, to be described over its whole surface; and, *first*, of those which might pass from south to north. If one were drawn for every degree of longitude, from the synclinal axis to the Rocky Mountains, it would be found (if its extremities rested on the sea) that the convexity of each would be greater than that of the preceding; and that the whole would traverse the rivers nearly at right angles. It would also be seen that, in the north, the lines thus projected would approach the level sea much more slowly than to the south; indicating that the broad region west and north west of Hudson Bay, inclines to the sea in a very gradual manner, and thus explaining its lacustrine character. If similar longitudinal curves were projected on the eastern side of the axis, the first two or three would rise with great regularity, pass over the high *plateau*, where we find the sources of the Mississippi, of Red River, and the St. Louis, and then sink to the level of Hudson Bay, by a rapid descent, intersecting many rivers in their progress. The next would display a different character. Ascending from the gulf, they would, after a regular rise to the latitude of thirty-four degrees north, mount over the spur of the Appalachian Mountains, which has been mentioned as stretching across the northern part of Alabama and Mississippi; descend, and traversing the Tennessee, Cumberland, and Ohio basins, at a hill summit elevation everywhere nearly the same, ascend the low summit level between the Ohio River and the Lakes; sink to the level of the latter, and beyond them rise to a higher level than attained before, from which to decline, at an equable ratio, into Hudson Bay.

Such a line, if projected on paper, would not be convex like those over the great plain west of the Mississippi, but serpentine, having three elevations and two depressions. Further east, we encounter the flanks and outliers of the Appalachian Mountains, which prevent one of these depressions; but the other, depending on the lakes, continues, and even deepens as the lake surfaces sink lower in the east.

In the *second* place, let us give attention to the surface curves of elevation and depression, which might be drawn transversely to the Valley, from east to west, and consequently at right angles to those which have been described. Everywhere west of the great synclinal axis, such curves would rise from it more rapidly, extend further, and ultimately attain to a greater and more uniform elevation, than those which might be extended from that axis to the east. Thus, from within the tropics to the latitude of thirty degrees, or the northern coast of the Gulf of Mexico, curves drawn from west to east, would descend with great rapidity from the summits of the Cordilleras of Mexico, at the altitude of ten or twelve thousand feet; cross the gulf, and rising, terminate on the mountains of Cuba, and on the still lower water table, which traverses the long peninsula of Florida, from south to north. From the northern coast of the gulf to the shores of Lake Michigan, such lines would descend rapidly from the lofty spines and peaks of the Rocky Mountains; then curve more gently over the broad, inclined plain which stretches from the base of those mountains to the synclinal axis; dip into that axis, reäscend, and traversing the narrower and less elevated plain to the east, rest on the summits of the Appalachian range, at an altitude a third or fourth as high as that of their western extremities.

A specimen curve of this class is given in *Pl. II, Fig.* 2. For want of the requisite data it could not be projected under one parallel, but its extremities differ only a few degrees. The scale on which it is executed did not, moreover, admit of its being started from the summits of the Rocky Mountains, but they are indicated on the plate. Beginning at the South, or Fremont's Pass, it takes the course of the Sweetwater and Platte Rivers; passes thence to the Kansas; descends that river to its mouth, and then continues down the Missouri to the Mississippi; — having traversed the great western plain, from the hight of thirteen thousand five hundred and seventy feet (if we *suppose* it projected from Fremont's Peak) to that of three hundred and eighty-eight feet, the elevation, according to Nicollet, of the great synclinal axis, at the mouth of the Missouri River. It now reäscends, and, still bearing a little south of east, passes over Illinois and Indiana; crosses the Ohio River at the Falls; traverses the state of Kentucky, and may be supposed to terminate on the Balsam Mountain of Virginia; which Professor Rogers informs me has an altitude of five thousand two hundred feet. *

This profile, while it demonstrates the true valley character of the interior of the continent, will serve, especially, to illustrate the portion which lies between the thirty-third or thirty-fourth and the forty-first parallels of latitude. In passing further north, the form of the curve undergoes a change.

A line projected in the forty-second degree would descend, like the last, from the summits of the Rocky Mountains; cross the synclinal axis, where the surface of the Mississippi is six hundred feet above the sea; then curve over hills two hundred feet higher; then sink to the level of Lake Michigan, five hundred and seventy-eight; traverse that lake; rise to one thousand over the water shed between it and Lake Erie; cross the south-western portion of that lake; and ascend the mountains of New York and Pennsylvania, to an elevation of two thousand feet. Another, in the latitude of forty-three degrees, would describe a curve of the same kind, to the synclinal axis, at Prairie du Chien, where the surface of the Mississippi is six hundred and forty-two feet above the sea; then ascend the water table between that river and Lake Michigan, three hundred feet higher; traverse the lake and the water shed to its east as before; sink to the level of the straits which connect Huron with Erie, five hundred and seventy feet; then rise to the elevation of from eight hundred to one thousand feet, in traversing Canada, north of Lake Erie; then sink to five hundred feet at the Falls of Niagara; pass on through Western New York, near the same level; descend the valley of the Mohawk, enter that of the Hudson, and, by a little deflection to the south, terminate on the Atlantic Ocean, at the city of New York. A curve in the latitude of forty-four degrees, intersecting the synclinal axis at an elevation of six hundred and eighty-four feet, would have all the inflexions of the last; sink to the level of two hundred and thirty-two feet, at the efflux of the St. Lawrence from Lake Ontario; then reäscend, and terminate on the summits of the Adirondack Mountains, in northern New York, at the altitude of four thousand feet. The curve of the next parallel, forty-five degrees, descending from the mountains like the rest, would intersect the synclinal axis where the surface of the St. Peter's River, occupying it, is nine hundred and forty-six feet, or thirty feet below its greatest elevation; ascend the high lands between that river and the Mississippi; pass the Falls of St. Anthony, eleva-

* The data for this curve are derived from Fremont, Nicollet, the civil engineers of Illinois, Indiana, and Kentucky, and the geologists of Virginia. Many of the altitudes west of the Mississippi are those of rivers, at low water, while those to the east are the summit levels of the low hills. My draughtsman, Captain Fuller, has endeavored to show the different kinds of surface — prairie, woodland, and river.

ted eight hundred and fifty-six feet; rise to one thousand before descending upon Lakes Michigan and Huron, with their intervening water shed as before; then traverse Canada West; sink to the level of the St. Lawrence a short distance above Montreal; and finally, by a rapid ascent, rest on the Green and White Mountains of New England, at the altitude of four or five thousand feet.

The curve of forty-six degrees would pass over the head of the *Coteau des prairies*, which is two thousand feet in hight; then intersect Red River in the synclinal axis a little north of its greatest elevation, at the altitude of about nine hundred and sixty feet; then rise upon the sloping plain, from twelve to fourteen hundred feet high, on which the Mississippi descends; then range over the water shed between Lake Michigan and Lake Superior, at a still higher altitude; then sink to the level and pass through the northern margin of Lake Huron, at five hundred and seventy-eight feet; to rise again as it traverses Canada, to the general hight of eight or nine hundred feet; then descend and cross the St. Lawrence a short distance above tide water; after which, suddenly rising, to rest upon that portion of the Appalachian chain which is found in Lower Canada and the state of Maine, at the hight of three thousand feet. The curves, representing the forty-seventh and forty-eighth parallels of latitude, cut the synclinal axis where Red River, which still occupies it, has an elevation of more than eight hundred feet; whence they mount upon the plateau, about fourteen hundred feet high, on which, and between which parallels, the Mississippi, Red River, and the St. Louis have their sources. From this elevation they descend to Lake Superior, six hundred and twenty feet, which they traverse from end to end; then reäscend to the general elevation of one thousand feet, as they traverse Canada; then descend to tide water, in crossing the St. Lawrence below Quebec; whence they rise upon the last portion of the Appalachian Mountains, south of that river, and cease at the elevation of about three thousand feet. The parallel of forty-nine degrees, gives a curve which descends on the water shed between the Missouri and the Saskatchawan of Hudson Bay; dips to the level of about eight hundred feet, in crossing Red River in the synclinal axis; rises, touches the Lake of the Woods, passes along the water shed between Hudson Bay to the north, and Lake Superior and the St. Lawrence to the south, at the altitude of fifteen or eighteen hundred feet; then suddenly sinks into the estuary of the St. Lawrence, and passes out to the Atlantic Ocean. This curve is distinguished from the preceding, by the high and uniform level which it maintains; and by representing, through nearly its whole length, the water shed which separates the streams which flow into Hudson Bay, from those which cast their waters into the Gulf of Mexico, the Lakes, and the St. Lawrence.

The curves of the next two parallels, in descending, cross the synclinal axis in Lake Winnipeg, at the level of seven hundred and fifty feet; then reäscend, but not to as high a level as the last; pass near to the south-eastern projection of Hudson Bay; rise over the expiring extremities of the Appalachian chain beyond the St. Lawrence, and then suddenly sink to the level of the ocean.

The high lands, or mountains, near the eastern margin of the continent, are now at an end, and the valley plain opens out upon the Atlantic Ocean, or Davis' Strait. We have now arrived at Hudson Bay, which penetrates into the very heart of the continent. On the west, however, the lofty Rocky Mountain border, continues unbroken and unreduced in altitude. The curves of every parallel of latitude, descend as before from their summits, and reach their lowest level in Hudson Bay; beyond which, through eight or ten degrees of latitude, they rise to the (uncertain) elevation of nine hundred or one thousand feet, and terminate with the coast of Labrador. From the sixtieth to the seventieth degree, the curves still descend from the high level, but terminate in Hudson Bay, or the straits which connect it with the Polar Sea.

Thus, we find that the curves in the extreme north, are almost identical with those of the extreme south; and that the configuration of the Valley, after we reach Hudson Bay, is nearly the same with that around the Gulf of Mexico.

The mechanism of the Interior Valley may be still further illustrated, by supposing certain horizontal planes or lines, to be carried in various directions over its surface. Thus a horizontal plane, at the altitude of twelve thousand feet, applied to the whole range of Rocky Mountains, from the latitude of eighteen degrees to sixty-eight degrees, north, would cut through many peaks, and pass over many others; the excesses and defects of elevation, perhaps, nearly compensating each other; and a plane at the elevation of three thousand five hundred or four thousand feet, applied to the Appalachian range, would give nearly the same result; and if a plane at this elevation were carried from the entire length of the Appalachian Mountains, westerly, it would not reach the Rocky Mountains, but cut the great prairies far on this side.

The plane at the elevation of a thousand feet, or of the culminating line or the synclinal axis, at Lake Traverse, nine hundred and seventy-five feet, would pass a little above, or rest upon, or cut through, the summits of those portions of the Valley which are comprehended in the following states: Iowa, Missouri, except the Ozark Hills, north-eastern Mississippi, north Alabama, middle Tennessee, western and middle Kentucky, Ohio, Indiana, Illinois, Wisconsin, Michigan, and Canada West. The same plane, carried to the north, would apply with equal accuracy to a far greater area. Finally, a series of horizontal planes, rising from two hundred and thirty-two to seven hundred and fifty feet, and then sinking through the same scale, would rest on the surfaces of all the great lakes, from Ontario up to Winnipeg; and thence down through Deer, Athabasca, and Slave, to Great Bear Lake; the whole lying in one axis (broken only by the high lands between Superior and Winnipeg), and ranging with the longest diagonal of the Valley, from south east to north west. One extremity of this range is in latitude forty-three degrees north, and longitude sixty-seven degrees west; the other in latitude sixty-seven degrees north, and longitude one hundred and twenty-four degrees west.

SECTION IV.

GEOLOGICAL OUTLINE.

Having shown the peculiar geographical and hydrographical system of the Great Valley, it will be proper to give a comprehensive introductory notice of its mineral geology.

I. The soil or loose covering of the surface of a country consists naturally of the *debris* of the subjacent rocks, gradually accumulating upon them, and varying in depth and qualities according to their mineral constitution. As some rocks undergo disintegration much more rapidly than others, it follows, that they have covered themselves with a deeper bed of their ruins. Thus the shales, marls, and soft slates, with many sand and limestones, decay more rapidly than granite, or syenite, and other primitive rocks, and therefore have a thinner soil.

When the rains wash this pulverulent *debris* from the hills to the valleys, it is borne along by the streams, and gradually deposited in beds, which are raised higher by each sucessive inundation of the banks. These are the alluvial grounds or bottom lands. In composition they are by no means so simple as the soils which remain *in situ*, for the wreck of various strata are mingled, and a variety of organic matters, transported by the waters, become enveloped in them. By this transportation, it may happen, that the banks of the lower portions of a river, or the shores of a lake in which it disembogues, may be composed of materials widely different from the rocks on which they rest; of which our Great Valley presents many striking examples. All its rivers, when swollen by rains, and some even in their lowest depression, transport a variety of materials; and often deposit them at great distances from their original beds; thus creating a most extensive and complicated system of alluvial grounds; some of which become dry after the freshets have subsided, while others remain permanently covered with water, in the form of shallow ponds, marshes, or mere swales. It is not practicable, to estimate the area of these grounds; but they are so continuous, that every part of the Valley, from mountain to mountain, and from sea to sea, might be traveled over, without leaving them except to cross the streams by which they have been deposited.

II. What has been said, affords but a limited conception of the surface of the Interior Valley. Along many of its rivers, and even mill streams, there are, in the rear of the alluvial bottoms, older and higher deposits of transported materials; which, it may be seen at a single glance, were made by rivers incomparably deeper and broader than those which now flow in the same valleys. These are commonly called second bottoms, and might sometimes receive a still higher numerical designation; for, now and then, we see a third terrace. From the great length of time since they were deposited, the organic matters which they enveloped, are dissolved; and, as they are no longer subject to river inundations, their surfaces are seldom marshy. In the aggregate, these ancient deposits are of less area than the recent alluvions, for they are found along a part of our rivers only.

III. Nearly related to, if not identical with, these old terraces, are the deposits on the general surface of the country; overspreading the hills and valleys alike, and varying in depth from a few feet to a hundred or more. They are found from the level of the sea in the south, up to the hight of at least fifteen hundred feet; both on the mountain slopes and elevated portions of the Valley plain. The materials which compose them, are water worn, and their arrangement, not less than their miscellaneous character, shows that they have been transported from the north. Nearly coëxtensive with these deposits, we find immense bowlders, or blocks of granite and other primitive rocks, at vast distances from their parent strata, indicating not only great depth of water, but buoys of moving ice in which they must have been imbedded.* Medical geology does not require a further development of this subject, and it only remains to add, that these deposits have received the different names of diluvion, drift, and post tertiary; and that they give to the regions in which they abound, a surface which bears no relation in its mineral character, to the rocks which are buried up beneath. They have, also, by filling up the inequalities of a rocky surface, produced one of greater levelness, and thereby favored the production of ponds and marshes.

IV. We must now penetrate the loose, upper coverings, and briefly indicate the nature of the strata below. In doing this, if we begin, as in the study of our physical geography, at the Gulf of Mexico, and proceed up the Valley, along its synclinal axis, we shall find that different rocks successively crop out; each to constitute the surface for a certain space, and then to be succeeded by a deeper, which has emerged from beneath it. We shall also find, that we pass progressively from the very newest to the oldest; though all the formations which lie between those extremes, in all countries, may not be met with. Thus, around the Gulf of Mexico, we begin on broad and deep alluvial deposits; then rise on diluvial or post tertiary, and then on tertiary. To these, in southern Alabama and Mississippi, succeeds a cretaceous deposit, extending into west Tennessee; followed by the coal formations of Illinois and Missouri; then, advancing, we arrive, in northern Illinois and Wisconsin, upon the Devonian shales and sand stones, which underlie the coal basin; then upon the Silurian or transition limestones, sandstones, and slates, and lastly upon granite and other primitive rocks; which stretch northerly

* Drake. Trans. Amer. Ph. Soc. New Series, Vol. II, 1818.

from Lake Superior to the Polar Sea. To the east and west of the line supposed to have been traveled over, most of these formations spread out with great regularity and amplitude. Thus, there is a geological, not less than a geographical unity, in the Interior Valley. Not the unity of a single formation, existing everywhere, but the unity of one system of formations; deposited on a scale of vast extent, and subsequently subjected to the same influences, whether conservative or destructive. In no other country, over an equal area, is the geological structure so simple and uniform; in no other does it so decidedly constitute the whole into one natural region.

It is an obvious truth, that these formations have undergone but few disruptions, from any force acting beneath. The Ozark Hills of primitive rock in Arkansas and Missouri, have, it is true, been pushed up through the secondary; and, in the former state, there are some volcanic appearances, in the midst of which we find the hot springs of Washita; still further, the great earthquakes of 1811, had their focus in the same quarter. But the whole region is of insignificant extent, compared with the entire Valley, which elsewhere shows scarcely a vestige of volcanic action. If, however, the rock formations of the interior of the continent, still lie in their original position, all that were deposited are not here now. Our best geologists have come to the conclusion, that much has been washed away; that vast submarine currents have swept the continent from north to south; scooped out or deepened the Valley by cutting down its strata; produced the general levelness of its surface, and finally, left upon it the primitive bowlders and other drift or post tertiary deposits, which have been described.

SECTION V.

HYDROGRAPHICAL BASINS.

The further study of the physical geography and topography of the Great Valley, or tropico-arctic plain, requires it to be divided into regions, a task of no great difficulty after the descriptions through which we have passed. In the absence of mountain ranges, to serve as natural dividing lines, it becomes necessary to resort to rivers; not, of course, using them as they are employed in designating the boundaries of political states, but referring to their arrangement into distinct basins, and to their confluence in different seas. On this principle, then, we proceed with our analysis.

I. When the eye rests upon the map of North America (*Pl. I*), it soon perceives where the great water sheds, or lines of division, lie. One of the most important, begins in the Appalachian Mountains, at the northern sources of the Alleghany River, in the state of New York, about north latitude, forty-two degrees fifteen minutes, and west longitude seventy-eight degrees and thirty minutes; whence it proceeds, almost parallel to the axis of Lake Erie, that is, to the south west, until it reaches the forty-first degree;

when it turns northerly, and passing round the head or southern end of Lake Michigan, advances into the region west of Lake Superior; having separated the rivers which flow into the Lakes, from the tributaries of the Mississippi. It has now attained the mean latitude of forty-eight degrees, and, by its inequalities of surface, determines the waters which fall upon it, in three different directions — toward the Gulf of Mexico by the Mississippi, the Gulf of the St. Lawrence by the River St. Louis, and Hudson Bay by Red River. Beyond this, to the west, it is cut through by the synclinal axis, in which we find a point, whence the streams flow to the south and north. It then rises and bears away to the Rocky Mountains, in north latitude fifty-one or fifty-two degrees; separating, in its progress, the Missouri of the south from the Saskatchawan and other rivers of the north. Here then we have a water shed, which, extending from one mountain range to the other, traverses thirty-six degrees of longitude, changes its latitude from forty-two to fifty-two degrees, and cuts off nearly one third of the Valley from the rest. Let us survey it a second time, with a view to its altitudes. Beginning, as before, at the sources of the Alleghany, Genessee, and Susquehannah rivers, in New York and Pennsylvania, we find in different places, the mountain elevation of this water shed to vary from thirteen to eighteen hundred feet — fourteen hundred may, perhaps, be received as an average. Going westerly, through Ohio and Indiana, it gradually sinks, until, at Chicago, in Illinois, it has fallen to six hundred feet; the elevation of the lake being five hundred and seventy-eight. From this depression it rises as regularly as it had fallen; and on following it to the region west of Lake Superior, at the sources of the Mississippi, we find it restored to its mountain elevation, of from thirteen to seventeen hundred feet. It then sinks, in the synclinal axis, to nine hundred and seventy-five; beyond which it gradually rises, with the great inclined plain, to the Rocky Mountains.

The eastern boundary of this division of the Great Valley is, of course, the Appalachian Mountains, at the sources of the Alleghany, Monongahela, Kenawha, Cumberland, and Tennessee Rivers, round to the state of Georgia; with the low water shed through the western part of that state and the center of Florida; in other words, the eastern limits of this portion of the Great Valley as already defined. The western boundary is the Rocky Mountains.

The greater part of the waters of this extensive region, find their way to the gulf, through the Mississippi; but the rivers of Texas, of the eastern margin of Mexico, of the eastern side of Mississippi, of the whole of south Alabama, of the western margin of Georgia, and the western half of Florida, reach the gulf by their own proper channels. Hence the Mississippi drains but a part of this region, and cannot, properly, give its name to the whole, which I shall therefore call the SOUTHERN, OR MEXICAN HYDROGRAPHICAL BASIN.

II. Starting, as before, from the mountain sources of the Alleghany River, we advance northerly, between them and the sources of the Susquehannah, on the right, and those of the Genessee and Oswego, of Lake Ontario, on the left. In the valley of the Mohawk, about the parallel of forty-three degrees, the water shed sinks to the hight of four hundred and twenty-five feet; but soon rises to the altitude of as many thousands, and winds among the Adirondack Mountains, between Lake Ontario and Lake Champlain; where it separates the waters which flow into those lakes and the St. Lawrence, from those of Hudson River. It is then depressed to one hundred and forty-seven feet, between that river and Lake Champlain; to rise upon the Green Mountains of Vermont, the White Mountains of New Hampshire, and the mountains of Canada East, to their termination at Cape Gaspé, on the Gulf of St. Lawrence; about the latitude of forty-eight degrees north, and longitude of sixty-four degrees west. On the north side of the gulf, it recommences west of Davis' Straits, not far from the sixty-fourth meridian, and fifty-third parallel; and passing south of west, divides the waters of the St. Lawrence from those of Hudson Straits and Bay. Approaching Lake Superior, it winds round the northern curve of that lake (to which it approaches very near), separating its tributaries from the rivers of the southern extremity of Hudson Bay; and continuing to the south west, divides the short rivers which fall into Lake Superior, from the longer which flow into Lake Winnipeg; until it reaches the great culminating center, on which the Mississippi has its origin. From this plateau, round the southern side of the Lakes to the place of starting, on the table land of the Appalachian mountains, the boundary is, of course, that already traced out. The area of this basin is much less than that of the southern or Mexican. As *all* its waters find their way to the ocean through the St. Lawrence, it may be named the ST. LAWRENCE HYDROGRAPHICAL BASIN. Other appellations, however, would be almost equally proper. Embracing so many great lakes, it might be called the BASIN OF THE LAKES; and, comprising the eastern portions of the Valley, a term expressing that fact would be appropriate. Extreme precision would adopt EASTERN for the whole, and *Lake* and *St. Lawrence* for its two great divisions.

III. The region which pours its waters into Hudson Bay, extends from the seventieth to the one hundred and fifteenth degree of west longitude; that is, like the Mexican Basin, quite across the Interior Valley; while that last described, is set into one of its sides. The southern boundary of the region which throws its waters into Hudson Bay is, of course, the northern boundary of the two basins just described. Its northern boundary, commencing at the Rocky Mountains, about the fifty-fourth parallel, is the flat water shed, which, running to the north east, separates the waters of the Athabasca River and Lake, on the left hand, and those of the Saskatchawan and Missinippi, or Churchill, on the right. Turning to the north, about the one hundred and fifth degree of longitude, it divides the waters of Athabasca Lake, and Great Slave Lake, from those of Chesterfield Inlet; after which, it turns north eastwardly, and gives origin to streams which fall into the Thleweechok, or Back's River, of the Polar Sea; beyond which, round to Melville Peninsula, it has not been traced; nor has that to the south of Hudson Strait, between the Bay and the coast of Labrador. The width of this region, from south to north, is about twenty degrees of latitude. It may be called the HUDSON HYDROGRAPHICAL BASIN.

IV. The remainder of the Great Interior Valley, constitutes the POLAR HYDROGRAPHICAL BASIN; which includes the whole northern sea coast of the continent, from Baffin Bay to the Rocky Mountains. From the proximity of Hudson Bay on the south, the Polar Basin does not extend far in that direction, until after we have passed westwardly beyond that bay, when it dips south to the fifty-fourth degree of latitude; and embraces the various streams which make up McKenzie River. Its western boundary is, of course, the Rocky Mountains. Its northern boundary, the Polar Sea, is about the sixty-ninth or seventieth parallel — its longitudes from the ninety-third to the one hundred and thirty-seventh degree; but in estimating its area, we must not forget the great reduction of length in the degrees of longitude within the polar circle, where this Basin has its extreme breadth; still, it is of greater area than the St. Lawrence, though not equal to the Hudson Basin.

We have thus, for the convenience of future topographical description, divided the Great Interior Valley into four natural HYDROGRAPHICAL BASINS:

1. The SOUTHERN, or MEXICAN.
2. The EASTERN, LAKE, or ST. LAWRENCE.
3. The HUDSON.
4. The ARCTIC, or POLAR.

In concluding this general geographical and hydrographical analysis, it may be well to say a word on political jurisdictions. The Southern Basin chiefly belongs to the United States; its south-western portions and extreme southern, to Mexico. The St. Lawrence Basin is divided, almost equally, between the United States and Great Britain. A small part of the Mexican Basin (north of the Missouri) lies within British jurisdiction; while a larger portion of the Hudson, projects into the United States. All the rest of that Basin, and the whole of the Arctic, appertain exclusively to Great Britain. In population, they rank in the order in which they have been named. In proceeding to their topographical analysis, we shall begin with the Southern.

CHAPTER II.

THE SOUTHERN HYDROGRAPHICAL BASIN.

GULF OF MEXICO.

In proceeding to analyze the Southern Basin, I shall treat, first, of the Gulf; second, of the Mississippi River and its banks; third, of the regions west of the Gulf and River; fourth, of the regions to their east.

The natural relations between the Gulf of Mexico and the Interior Valley of North America, which it limits to the south, are so intimate, that without a preliminary study of the former, no successful progress can be made in the medical topography, hydrology, climate, and endemic diseases of the latter. Beyond this, however, the gulf has claims upon our attention; for the commercial cities, fortresses, and naval stations, which must forever surround it, require that a chapter should be devoted to its description. This I shall do under the following heads — *Position, Form, Area, Depth, Currents, Temperature, Tides, Inundations, and Coasts.*

SECTION I.

POSITION, FORM, AND AREA.

The ninetieth meridian west, and the twenty-fourth parallel north, intersect each other very near the center of the Gulf of Mexico, and thus fix its mean latitude and longitude. The extremes of the former are from a little below eighteen to a few minutes above thirty degrees north — those of the latter, between eighty-one and ninety-eight degrees west.

From Cape Catoche, the termination of the peninsula of Yucatan in the south, round to the Rio del Norte, in the west, it washes the coasts of Mexico; on which we find Vera Cruz and Tampico. On that side, the Cordilleras approach it so near, that some of their peaks can be seen from its surface. North east of the Del Norte, it washes the shores of Texas, Louisiana, Mississippi, Alabama, and Florida. Its remaining land limits are the Island of Cuba to the south east. Thus, low lands surround it on every side, except the west. This mediterranean sea has two important connections with the Atlantic Ocean: one on the south by the Strait of Yucatan, between Cape Catoche and Cape Antonio, where it opens into the Caribbean Sea; the other on the east, by the Strait of Florida, between Cape Sable and Havana.

In reference to the terrestrial zones, it is divided almost equally between the torrid and temperate.

Its figure rudely approaches a broad, irregular oblong. Its north and south sides are pressed toward each other, near their middle, by the delta of the Mississippi and the promontory of Yucatan, a line from one to the other being the shortest by which it can be crossed.

Its area, if we take seven hundred miles for its average width, and one thousand for its mean length, is seven hundred thousand square miles. It may be more or less, but exactness on this point is not required, for all demands of our object are satisfied, by knowing that immediately south of the Interior Valley there is an extensive body of warm water.

SECTION II.

DEPTH.

The following statement of facts bearing on this point, has been sent me by Lieutenant Maury, of the Hydrographical Office, Washington:— "Little is known as to the depth of the central part of the Gulf, except that it is beyond the usual reach of the "deep sea lead"— say one thousand feet. There is a belt of soundings all around the Gulf, varying in breadth from a few miles to one hundred and forty or one hundred and fifty. For example: north of Cape Catoche the water gradually deepens for one hundred and forty miles, until no bottom is reached at one hundred and ninety-eight fathoms. So, also, from the Tortugas one hundred and eighty miles to the north east, it deepens, from sixty fathoms near those islands, to no bottom with a line of one hundred and sixty-two fathoms; which point is also about one hundred and eighty miles from the nearest point of the Peninsula of Florida. So, too, south of Appalachicola the shoal water extends off two hundred and fifty miles to soundings of one hundred and twenty fathoms. With these exceptions, if you will draw a line parallel to the shore, and about fifty miles from it, entirely around the Gulf, this line will run along in about two hundred feet of water."

Thus the bottom near the shore of the Gulf presents the junction of two curved inclined planes, an earthy and an aqueous;—a mechanism which suggests that a process of filling up has long existed, and may still be going on. At the same time, the entire bed may be rising. Admitting these operations, we may say, that the former leads to extension of the land; the latter, to recession of the waters. And that a change in the relative levels of the two has taken place within a modern (geological) period, is rendered certain, from the existence of long, low banks of recent marine shells, which lie (in various places near the shore), several feet above the present level of the water. At what ratio this process has been carried on, or is now proceeding, is unknown.

SECTION III.

CURRENTS.

It is held as a fact, by marine hydrographers, that the trade winds, from the coast of Africa to that of South America, by acting on the surface of the Atlantic Ocean, impede its movement to the east, in the direction of the earth's rotation; and thus cause an accumulation of the retarded water against the American continent, between the tropics, whence it flows off laterally. The currents to the north are all that demand attention from us. These, following the coast of South America, enter the Caribbean Sea by the Windward Islands, and traversing that sea, south of Hayti, Jamaica, and Cuba, pass through the strait between the latter island and the promontory of Yucatan, into the Gulf of Mexico. Humboldt recognizes this current as a reality; and Lieutenant Browning* informs me that the evidences of it are conclusive. *First.* In traversing those straits and the Caribbean Sea, south of Cuba, a ship's dead reckoning requires an allowance of half a mile an hour for a westerly current. *Second.* When ships depart from Jamaica for England, they prefer to sail to the west, and make a *detour* through the Gulf of Mexico, round the Island of Cuba; thus keeping with the current, which more than compensates for the increased length of the voyage. It would appear, however, that the tropical water, thus introduced from the Caribbean sea, does not make a circuit directly round the west end of the Island of Cuba, to the Havana and Florida Straits; but is diffused through the Gulf, performing in it a kind of circuit, and at last issuing through the straits just mentioned, as the well-known and celebrated Gulf Stream. On this point Humboldt holds the following language:

"The coast of Mexico, along the Mexican Gulf, may be considered as a dyke, against which the trade winds, and the perpetual motion of the waves from east to west, throw up the sands which the agitated ocean carries along. This current of rotation runs along South America, from Cumana to the Isthmus of Darien; it ascends toward Cape Catoche, and, after whirling a long time in the Mexican Gulf, issues through the Canal of Florida, and flows toward the Banks of New Foundland. The sands heaped up by the vortices of the waters, from the Peninsula of Yucatan, to the mouths of the Rio del Norte and the Mississippi, insensibly contract the basin of the Mexican Gulf. Geological facts, of a very remarkable nature, prove this increase of the continent. We see the ocean everywhere retiring. M. Ferrer found, near Sotto la Marina, to the east of the small town of New Santander, ten leagues in the interior of the country, moving sands filled with sea shells. I myself observed the same thing in the vicinity of Antigua and New Vera Cruz. The rivers which descend from the Sierra

* United States Navy.

Madre, and enter the Atlantic Ocean, have in no degree contributed to increase the sand bank." *

Further: Lieutenant Maury, of the Hydrographical office, Washington, writes me on this subject as follows:

"The current from the Caribbean sea, after passing the Yucatan Strait, varies in force and direction, so as often to produce many eddies and counter currents. Still, my own opinion is, that, for the most part, it performs the circuit of the Gulf; but not in any well-marked or constant channel. In corroboration of this I would mention the tides at Vera Cruz, for instance, which ebb and flow once in twenty-four hours at ordinary times; but which sometimes flow continuously to the north west, and at other times to the south east, for three or four days together; sometimes, again, there is neither rise nor fall for several days."

Again: The course of the Mississippi, from the mouth of the Ohio River to its termination at the Balize, seems to throw some light on this subject. For eight or nine hundred miles, its bearing is west of south, but when it reaches the vertex of its delta, at the mouth of Red River, it turns so far to the east, that, in flowing through two degrees of latitude, it makes nearly two degrees and a half, or one hundred and fifty miles, of longitude.

Now, by what agency has the direction of the river been turned and kept to the east, ever since it reached the Gulf at the mouth of Red River, and began to deposit that silt, of which the delta is composed? Has not a gentle circumferential movement of the gulf waters carried the silt in an eastern direction, while it was subsiding? Such a movement, however slow, would of necessity cause the deposits to fall where we now see them; that is, give to the delta and the new river bed, precisely the form and direction which they exhibit. The assumed cause explains the phenomena, and may therefore be admitted as a reality. If the river bed, on entering the gulf, turned to the west, we should certainly regard it as evidence that no currents flow from that direction.

Finally: Lieutenant Browning informs me, that, near the eastern margin of the Gulf, from the Tortugas and Key West, round to Pensacola, or even to the Balize, there is a gentle current from south to north. This is evidently an eddy, and implies a stronger current in the opposite direction; from the delta of the Mississippi, to the extensive reef which projects into the Gulf from Cape Florida to the Tortugas. Impinging against this reef, a part of the water is returned to the north, along the coast of Florida, while the remainder makes its way through the straits between that peninsula and Cuba, constituting the Gulf Stream.

Although we regard this Stream as depending essentially on the oceanic movements which have been described, we must not overlook the contributions to the Gulf, made by the rivers which enter it. Very little of this supply is furnished by the countries lying around the southern semicircle of the gulf,

* Pol. Essays on New Spain. Vol. I, B. I, Chap. iii. p. 62.

for all the rivers of western Cuba, of the Peninsula of Yucatan, and of that portion of the Republic of Mexico, which lies between it and the mouth of the Rio del Norte, near the latitude of twenty-six degrees north, are very short. If, however, the river supplies are almost limited to the northern half of the Gulf, they are still much greater, relatively to its area, than those received by closed seas generally, or by the universal ocean; for that portion of the continent from which they are derived, is nearly three times as great as the surface of the Gulf; thus reversing the proportions of land and water of the globe, taken as a whole.

SECTION IV.

TEMPERATURE.

As all the rivers of the Gulf, from the Rio del Norte to the Chattahoochee, flow from higher latitudes than those in which they mingle with its waters, (some of them, indeed, as the Missouri, from nearly twenty degrees further north), and as their sources are from five hundred to ten thousand feet above the Gulf, the water they throw into it has, of course, a temperature which must, to *some* extent, reduce that of the water with which it mingles. In the absence of more important observations on this point, I may be allowed to state the following: On the 13th of March, 1843, I found the temperature of the mouths of the Mississippi forty-four degrees, Fahrenheit. Five miles beyond the bar of the South West Pass, the river water, distinguishable from that of the Gulf by its turbidness and yellowish tint, was still the same in temperature; but that drawn up from a depth of sixty feet, being brackish and less turbid, was fifty-one, or seven degrees warmer. The temperature of the earth in that latitude, twenty-nine degrees north, is, however, about seventy, or nineteen degrees greater; showing that the Mississippi had exerted a cooling influence to an unascertained depth. Passing laterally out of this river current, to the distance of a few miles, in the midst of transparent salt water, I found the temperature at the surface fifty-seven degrees. Soundings were not made at either station; but as they were at the same distance from the shore, and the bottom is known to be an inclined plane, the difference between forty-four and fifty-seven degrees (thirteen) was undoubtedly attributable to the Mississippi. To what distance in the Gulf that difference extends, is unknown; but it is by no means as far as it would be, if the river discharged itself by one mouth instead of several.

These observations were made, however, when the river water had its minimum temperature. In the latter part of summer and in early autumn, it attains to more than seventy degrees; when its cooling effect is nearly or quite nullified. A few days after these observations were made, I found the surface of Lake Pontchartrain and Lake Borgne — shallow bays of brackish water, lying nearly a degree further north — to be fifty-six and fifty-five degrees. It is worthy of remark, that no river of any size enters the former; while the small rivers, Pearl and Pascagoula, discharge their waters into the latter; which, therefore, although a little further south, was one degree cooler. On the same voyage, I found the temperature outside of Dauphin Island, in the open Gulf, but in shallow soundings, fifty-six degrees; in ascending Mobile Bay, half a degree north of Lake Borgne, fifty-two degrees; and at the dock in Mobile, forty-nine degrees and a half. As the Alabama River, the largest tributary of the Gulf east of the delta of the Mississippi, discharges its waters into this Bay, we have additional evidence of the cooling effect of river water, in the sinking of the thermometer from fifty-six to forty-nine degrees and a half, in a distance of fifty miles. In 1844, April 10th, I found the heat of Lake Pontchartrain sixty-nine degrees; that of the Gulf, off Dauphin Island, seventy degrees; and that of Mobile Bay, sixty-five degrees, or four below that of Pontchartrain;—still showing the river influence.

But, of course, all the cooling of the northern margins of the Gulf is not referable to the influx of river water; for the winter exerts its influence, and with so much greater effect, as the waters are shallower. Still, the facts which have been cited demonstrate, that the atmospheric influence is reinforced by the fluviatile; and at certain times, when the mountain winds, called "northers," descend and sweep over the Gulf with great velocity, for several successive days, their cooling influence on the shallow waters of the Gulf is decisive, even as far south as Key West. I was assured, by the late estimable Commander Johnston, U. S. N., that when stationed on that coast, he had seen many of its fish benumbed, and even destroyed, by one of these long continued and violent winter tempests, acting on the shoal waters of the Florida Reef.

At what period of the year the cooling influence of the northern rivers and the northern winds, effects the greatest reduction of the temperature of the shallow waters of the Gulf, is not known; but from various considerations, we may fix the minimum between the end of February and the vernal equinox. If this be correct, the observations made in February, 1843, give us the minimum heat of the shallow waters, from the mouths of the Mississippi to Mobile Bay, inclusive, and the scale is, forty-four, forty-nine and a half, fifty-two, fifty-five, fifty-six, and fifty-seven degrees, according to the saltness, not the depth, of the water.

At what period of the year do the waters of the Gulf attain their maximum heat? This is not known, but in all probability, it is not far from the autumnal equinox. The following observations show, imperfectly, the ratio of increasing vernal temperature near the shore.

Dates.	L. Pontchartrain.	Lake Borgne.	Gulf.	Mobile Bay.
1843, March 13	56°	55°	56°	52°
1844, April 10	69°		70°	65°
" " 24			79°	80°

From these numbers it appears, that the rise of Gulf temperature in the spring, is at the rate of half a degree a day.

If the northern portions of the Gulf are cooled by these river currents, the southern are warmed by the great marine current, which enters it from under the equator, through the Strait of Yucatan. Under these influences, the temperature, in traversing it from north to south, ought to rise more rapidly than it would from the mere influence of climate; but we are in want of observations on this point; and, indeed, I have not been able to collect many experiments on the temperature of any part of the Gulf, beyond the limits just given. For the following, I am indebted to Lieutenant Maury, of the Hydrographical Office, Washington.

SURFACE TEMPERATURE OF THE GULF OF MEXICO.

Name of vessel.	Where from.	Where bound.	Month.	Tem. of water Min.	Tem. of water Max.
Vandalia,	Pensacola,	Havana,	Nov. and Dec.	72°	82°
Falmouth,	Havana,	Key West,	November,	76°	81°
Falmouth,	Pensacola,	Vera Cruz,	October,	78°	82°
Falmouth,	Vera Cruz,	Tampcio,	December,	74°	76°
Falmouth,	Pensacola,	Mouth of Mississippi,	February,	57°	64°
Falmouth,	Vera Cruz,	Pensacola,	March,	59°	75°
Mississippi,	Key West,	Pensacola,	August,	81°	86°

The value of these observations would be much greater, if the latitudes, distances from land, and depths of water, had been noted. The highest among them is eighty-six degrees, in the month of August, north of Key West. Mr. Lyell * has quoted from Major Rennall, another observation of the same amount; but in what latitude it was made is not stated. If we receive them as correct, we may conclude that the heat of the middle and southern parts of the Gulf, is several degrees higher than that of the Atlantic Ocean in the same parallels; a difference attributable no doubt to the introduction of tropical waters from the Caribbean Sea.

The existence, to the south of the Great Interior Valley, of this immense basin of tropical water, having a temperature several degrees higher, than if the strait between Yucatan and Cuba had no existence, is a hydrological condition, which deserves the attention of the meteorologist and etiologist of the Valley. If it were replaced by land, our south and south-west winds, in winter and spring, would fall far short of producing those thaws which, at present, they infallibly occasion, even in Canada, if they continue to blow for a few days. Taken in connection with the Rocky Mountains, it also explains the surprising reduction of temperature which follows on a change in the course of the wind, from a few points south of west, to a few points north of west; by which, currents that have passed over the warm surface of the

* Principles of Geology. Vol. I, p. 166.

Gulf, are replaced by currents from the snowy summits of those mountains. The physician will also perceive, that those who navigate the Gulf, or reside on its coasts, must, forever, be liable to the diseases which properly belong to the most southern climates.

SECTION V.

TIDES AND INUNDATIONS.

I. TIDES.—Along all the northern coasts of the Gulf the tides are of inconsiderable hight; especially in the rivers, where they are less than in the heads of small bays and inlets. In the mouth of the Mississippi, I was told by Captain Arnable, the observing commander of the towing steamer, Phœnix, that they ordinarily rise about a foot, the weather being calm. At new and full moons, they reach eighteen inches. Mr. Parker, an intelligent pilot, made three months of daily consecutive observations, at the Balize, in the South East Pass, having devised for the purpose a graduated scale. The highest, during that period, was thirty-three inches; the lowest less than a foot. When the Mississippi is low, the tide is said sometimes to manifest itself above New Orleans; the water, of course, being fresh. At Mobile, Mr. Troost, civil engineer, estimates their average hight at a foot. At Tampico, to the south west, they rise, however, as Lieutenant Browning informs me, to the hight of four feet.

II. INUNDATIONS.—A gale, to or from the land, may raise the tides to double their ordinary hight, or prevent them altogether, according as it promotes or opposes them. A tempest sometimes drives the waters up the rivers, and over the lowlands, creating a deluge. At the Balize, there is a tradition that in the month of August, 1812, the water at Fort St. Philips (*Pl. V*), thirty miles up the Mississippi, rose nine feet in half an hour; the Balize was, of course, inundated, and every cabin half way to New Orleans was removed from its foundation blocks. In August, 1831, the same place experienced another visitation. For several days preceding it, the reflected light of the sun displayed a greenish tint; showing a peculiar condition of the atmosphere. The 16th was rainy, with gusts. At night, the wind became suddenly fixed from the east; and blew with the utmost violence. On the 17th it continued, with copious rain, from clouds which hung very low; and, by night, the inundation was at its hight. Nearly all the people of the village were driven to their boats. The rise was many feet. These facts were given me by Mrs. Anderson, an observing lady, long resident at the Balize.

In Mobile Bay, on the 18th of October, 1841, as Mr. Troost informed me, a south wind, of five days' continuance, raised the water nine feet four inches; and, on the 4th of March, 1842, another, of ten days' duration, heaped it up several inches higher.

The isthmus on which New Orleans is built, suffers occasional deluges of the same kind, from Lake Pontchartrain, which convert the cypress swamps in the rear of the city, into deep ponds, and even flow over many of the streets.

In Pensacola Bay, the fury of the waves is directed upon the long, narrow dune of white sand, called Santa Rosa Island (see *Pl. III*), which they mount over, but falling into the Bay and Sound which lie in its rear, do no mischief.

Similar inundations are occasionally experienced, from the same cause, on the islands of Galveston and Key West.

In short, they occur throughout the whole coast, for everywhere it lies so low as to permit them. But they never happen in many places at the same time; for a wind which may occasion them at one locality, might blow the water from another.

The low shores of the Gulf must forever remain liable to these deluges, and of course they will always abound in pools and marshes.

SECTION VI.

COASTS.

What has been said on the shoal waters and inundations of the Gulf, will suggest the general character of its coasts — *everywhere low*. From Vera Cruz around to Cape Florida, there is not a single league of rocky, or iron-bound shore; nor any other harbor equal to that of Pensacola, the entrance to which is through water only twenty-four feet in depth. Everywhere the tides and waves fluctuate on sloping beaches of sand or silt; the latter being present, however, only at the mouths of rivers; and where it can be kept in place by the roots of grasses. The sand is generally white, and so fine as to be readily moved by the waves, or drifted by the winds. By these agents, dunes of irregular and ever-changing forms are built up; some of which constitute peninsulas, while others are severed from the main land, and converted into crescent islands. The watery surface is not less diversified than the earthy. Numerous creeks and bays of every size and form, lagoons, ponds, swamps, and marshes, are intermingled with the earthy deposits and drifts; and present, throughout a terraqueous margin; which sufficiently indicates that the surrounding continent is advancing upon the Gulf. Some of the pools and marshes consist of fresh water; others are brackish; others almost as salt as the Gulf itself. In some places there are long, navigable sounds, or lagoons, between the main land and the dunes or sand islands.

The principal bays are, Tampa, Appalachicola, Pensacola, and Mobile, to the east of the delta of the Mississippi; and Galveston, Matagorda, Espiritu Santo, Corpus Christi, Aransano, Santiago, and Tampico, to its west.

Besides these, smaller bays and lagoons are numerous. In reference to the western coast, Humboldt observes —

"The shore of the provinces of Santander and Texas, from the twenty-first to the twenty-ninth degree of north latitude, is singularly festooned, and presents a succession of interior basins from four to five leagues in breadth, and from forty to fifty in length. They go by the name of lagunas, or salt-water lakes. Some of them (as the Lake de Tamiagua) are completely shut in; others (as the L. Madre and the L. de San Bernardo) communicate by several channels with the ocean." *

Rivers enter the heads of many of the bays, and are filling them up with silt, in proportion to the extent and looseness of the surfaces which are drained. Of the whole, the Mississippi is the only river which has accomplished its work; having not only filled up its bay, but built up land from the bottom of the open sea; — an achievement which has resulted from its commanding the resources of a larger portion of the continent, than all the other rivers from Cape Florida to Vera Cruz. A striking and instructive effect has resulted from the partial filling up of many inlets. Their shores opposite the river deposits, are everywhere more infested with autumnal fever, than further down their estuaries, near the Gulf, where their banks and bottoms abound in sand derived from the margins of the tertiary or post-tertiary plain, which surrounds the Gulf. Beneath these deposits, on the eastern side of the Gulf, wherever rocky strata are to be found, they belong to the tertiary formations, and consist of friable lime and sand stones.

These general descriptions are applicable to the coasts of the Gulf east and west of the delta of the Mississippi; but do not apply to that immense alluvial deposit, which requires to be described separately; that description, however, must be given in connection with both the Gulf and River; and will, therefore, be deferred until we have examined the principal localities of the coast.

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* New Spain, Vol. II, p. 185.

CHAPTER III.

THE SOUTHERN BASIN, CONTINUED.

SPECIAL MEDICAL TOPOGRAPHY OF THE COASTS OF THE GULF OF MEXICO.

In proceeding to describe such localities as are of interest to the physician, a question of limits arises. Shall we take those places only which stand upon the Gulf, like Vera Cruz and Pensacola, or ascend the rivers which enter it, as far as settlements have been made upon them? The answer must be, that the former would be too restricted, and the latter too extended. I shall, therefore, take the intermediate limits of tide water, which will carry us to the heads of the river estuaries and of the little bays; and enable us to embrace, in the zone of the Gulf coasts, such localities as Fort Brooke and Mobile. In entering on this, the beginning of our medical topography, I propose to start with the most southern locality, Vera Cruz, on the western side of the Gulf, and travel north to the delta of the Mississippi; then, to begin anew, at the most distant point in the south, Havana, and travel northerly to the same delta.

SECTION I.

VERA CRUZ.

Vera Cruz, the most populous town and the commercial metropolis of the Republic of Mexico, and the largest city of the western Gulf coast, has at all times been an object of interest, with the medical etiologist; and yet I have not met with the materials for a satisfactory description.

Its latitude is 19° 11′ 52″ N., longitude 96° 8′ 45″ W. It was founded by the Spaniards near the close of the sixteenth or in the beginning of the seventeenth century, about two hundred and fifty years ago; on the spot where Cortes first landed for the conquest of Mexico.* We are indebted to Humboldt, for a sketch of its topography.

"It is situated in an arid plain, destitute of running water, on which the north winds, which blow with impetuosity from October until April, have formed hills of moving sand. These downs (*Meganos de Arena*) change their form and situation every year. They are from eight to twelve meters (twenty-six to thirty-eight feet) in hight, and contribute very much, by the reverberation of the sun's rays and the high temperature which they acquire during the summer months, to increase the suffocating heat of the air of Vera

* Clavigero's History of Mexico, Vol. II, p. 296.

Cruz. Between the city and the Aroyo Gavilan, in the midst of the downs, are marshy grounds covered with mangles and other brushwood. The stagnant water of the Baxio de la Tembladera, and the small lakes of l'Hormiga, El Rancho de la Hortaliza, and Arjona, occasion intermittent fevers among the natives. It is not improbable that it is, also, not one of the least important among the fatal causes of the *vomito prieto*, or yellow fever. All the edifices of Vera Cruz are constructed of materials drawn from the bottom of the ocean, the stony habitation of the Madrepores (piedras de Mucara), for no rock is to be found in the environs of the city." "Water is found on digging the sandy soil of Vera Cruz, at the depth of a meter (9.8 feet); but this water proceeds from the filtration of the marshes formed in the downs. It is rain water, which has been in contact with the roots of vegetables; and is of a very bad quality, and only used for washing. The lower people (and the fact is important for the medical topography of Vera Cruz) are obliged to have recourse to the water of a ditch (*zanja*), which comes from the *meganos*, and is somewhat better than the well water, or that of the brook of Tenoya. People in easy circumstances, however, drink rain water collected in cisterns, of which the construction is extremely improper, with the exception of the beautiful cisterns (*algibes*) of the castle of San Juan d'Ulloa, of which the very pure and wholesome water is only distributed to those in the military. This want of good potable water has been for centuries looked upon as one of the numerous causes of the diseases of the inhabitants."*

Such was the situation of the city, in 1803. Forty-two years afterward, A. D. 1845, when visited by Norman, it was not materially different, except that the population, which Humboldt stated at more than sixteen thousand, is given by Mr. Norman at six thousand. "The form of the city is semicircular, fronting the sea. It is situated on an arid plain surrounded by sand hills, and is very badly supplied with water,—the chief reliance being upon rain collected in cisterns, which are often so poorly constructed as to answer but very little purpose. The chief resource of the lower classes is the water of a ditch, so impure as frequently to occasion disease." "The outside of the city looks solitary and miserable enough. The ruins of deserted dwelling houses, dilapidated public edifices, neglected agriculture, and streets once populous and busy, now still, and overgrown with weeds, give an air of melancholy to the scene, which it is absolutely distressing to look upon." † Mr. Thompson informs us that there are large swamps in the rear of the city.‡

The castle of San Juan d'Ulloa, stands upon and nearly covers a rocky island, in front of the city.

According to Humboldt, the rich merchants of Vera Cruz, at the time of

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* Polit. Es. on New Spain, Vol. II, p. 175.

† Notes of Travel, p. 90—96.

‡ Recollections of Mexico.

his visit, had summer residences at the interior town of Jalapa, four thousand feet above the Gulf; where they enjoyed a "cool and agreeable retreat, while the coast was almost uninhabitable from the moschetoes, the great heat, and the yellow fever." That disease, it is well known, prevails in Vera Cruz every year; suspended, or nearly so, during the winter, but returning after the vernal equinox, with as much certainty, as intermittents and remittents recur, before the autumnal equinox, along the rivers of Illinois, or Alabama. According to Humboldt, it never extends into the country. It may be collected from him, that intermittents also occur in Vera Cruz, and at other places along that coast; but to what extent, I cannot discover; nor whether a disease, answering to the remittent autumnal fever of the more northern portions of the Valley, and distinguishable from yellow fever, is met with there.

SECTION II.

TAMPICO.

At the distance of about two hundred miles north-north west from Vera Cruz, in the state of Tamaulipas, we have the Mexican town of Tampico. Its position, in L. 22° N., is on the left or northern bank of the River Panuco, immediately below the junction of the River Tamissee, and six miles from the Gulf. These rivers, which resemble deep and winding canals, descend from the Sierra Madre, or eastern range of the Cordilleras; and traverse the broad, flat, and fertile zone, which surrounds the western segment of the Gulf. The Panuco flows from the south west, and the Tamissee from the north west. The interior, mountain city of San Luis Potosi, stands on the head waters of the former. Between these rivers, and also to the north and south, there are long, narrow lakes, running nearly parallel to the Gulf Coast, with many communications between them and the rivers. The region around Tampico is not, like that around Vera Cruz, a vast field of drifted sand; but is covered with a productive soil, and a luxuriant, natural or cultivated vegetation. The town is built on a bold and rocky bank, above high water mark, without any intervening foul beach, as the deep water extends to the foot of the bank. In its rear, to the north and north-west, the ground remains wet for a while after great rains; but there are in that quarter no permanent ponds. To its west, between the two rivers, there is a lake marsh, and on the further or south side of the river, the head of a narrow lake which stretches off to the south.*

Tampico is the most important town on the western side of the Gulf, between Vera Cruz and Galveston. The country in its rear is attractive to agriculturists; the rivers which traverse it, facilitate communication with

* Norman: Rambles by Land and Water, 1845.—Lieutenant Browning, U. S. N.

the interior; and the harbor itself is more accessible than most others on the western side of the Gulf. The commercial intercourse between this place and New Orleans, always considerable, is likely, hereafter, to be so much greater as to give to its medical topography a decided importance. From Lieutenant Browning, I learn that intermittent fevers prevail, especially in spring; but as the summer comes on, they are merged in yellow fever, which, as at Vera Cruz, may be regarded as the great and never failing endemic.

SECTION III.

GALVESTON ISLAND AND TOWN.

This is at once the name of a bay, an island, and a new American city, of the state of Texas. The *Bay* has the form of an irregular parallelogram; with one end on the Gulf, and the other forty miles north, in the country. The San Jacinto enters its north-west, and the Rio Trinidad, or Trinity River, its north-east corner. Its width is from twelve to eighteen miles, with an average depth of nine or ten feet; reduced to five or six, over Red Fish bar, which bisects it into nearly equal parts.

The Island lies with its eastern half immediately in front of this bay, within a mile of the main land; and extends west south-west, in a straight line, to a length of thirty miles, with a breadth of four or five. The harbor is between the eastern end of the island and the mouth of the bay, with an entrance from the east.* At the entrance of the bay, there is a low, flat island, containing about one thousand acres, which, with Bolivar Point, a promontory of the main land, limits the harbor to the north. Galveston island is but a compact bed of drifted sand, rising a few feet above the level of the Gulf, and liable to partial inundation, from the fluctuations produced by strong southern and eastern winds.

The City, of which the Lat. is 29° 18′ N., and Lon. 96° 6′ W., stands adjacent to the harbor, on the north side of the island. Near the water's edge, in front of the former, the surf has thrown up a levee of sand and shells about two feet high in its center, and one hundred feet broad; immediately in the rear of which, is a broad depression, so low that high tides run into it, and rain water accumulates, so that it presents either a marsh or a sheet of water, three-quarters of a mile long, and from one to three hundred feet broad. The principal business street, called the Strand, runs upon this natural levee; and on the south side are the warehouses, which run back over the morass, which receives their filth. The rest, and more interior portions of the city, are built on a dry and porous soil, and present an aspect of cleanliness and comfort.†

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* Texas; by Mrs. Mary Austin Holley, 1836, p. 26.

† An account of the Yellow Fever, which appeared in the city of Galveston, 1839: by Ashbel Smith, M. D.

Until about 1836, Galveston island was uninhabited; in 1837, the emigration to it, from the United States, became active; in 1839, the city contained from two thousand to two thousand five hundred inhabitants, and the number has been increasing ever since. Galveston has experienced several invasions of yellow fever, when that disease was epidemic in New Orleans. It is also liable to the common forms of autumnal fever.

Between Galveston and the delta of the Mississippi, there is no coast locality of interest, and in pursuance of the plan already announced, we must now transfer ourselves to the eastern side of the Gulf.

SECTION IV.

HAVANA, AND THE ISLAND OF CUBA.

Although the Island of Cuba makes no part of the Interior Valley of North America, the relations between them are so intimate, that the medical historian of the latter, should include the former in his descriptions.* These relations are three fold: 1. The meteorology of Cuba gives us a tropical starting point for tabular views of the climates further north. 2. It is impossible to study the yellow fever of the northern shores of the Gulf, without a reference to the city of Havana. 3. That city and the island to which it belongs, are the chief places of resort for those invalids of the Valley, who seek a southern winter residence.

Cuba is a long, narrow island, lying nearly east and west, between the latitudes of twenty and twenty-three and a half degrees north. Its extremities and center are elevated and broken; in fact, may be regarded as a mountain of the sea. The greatest hights are in the eastern extremity of the island, where the Pico de Tarquino rises to the altitude of eight thousand four hundred feet.

But as this portion of the Island lies in the seventy-seventh degree of west longitude, it is too remote from the Gulf of Mexico and the coast of Florida to exert any perceptible effect on the climate of either. The Island, moreover, presents its extremity instead of its side to the Gulf, which greatly reduces the influence it might otherwise exercise. Intermittent fever, but not yellow fever, prevails along the rivers of Cuba.†

HAVANA (*Pl. I*) stands on the northern margin of the island, near its western extremity, in N. Lat. 23° 9′ 27″, and W. Lon. 82° 22′ 53″, about one hundred miles from Cape Florida. A capacious harbor, with high, rocky portals, washed by the Gulf Stream, abounds in shipping, at all seasons of

* I have not been able to meet with any full description of the medical topography of Havana; and the account which I expected from a highly intelligent medical friend, once resident there, has not come to hand.

† Notes on Cuba. By a Physician.

the year except the hottest. The city stands on a plain, which lies on the western side of this harbor, and is surrounded by hills. * In one corner of the plain, near the harbor, there is a swamp, the exhalations from which are wafted over the city and shipping. The streets are narrow, and kept passably clean. † Its settlement was begun by Spain, in 1519. Its commerce is with nearly all the civilized world. Ever since the yellow fever attracted attention, or was recognized as a distinct disease from the remittent autumnal fever of the temperate zone, it has prevailed as an endemic of Havana, raging epidemically from April until December, and occurring sporadically throughout the remainder of the year. Thus, in reference to that fever, Havana and Vera Cruz are in a manner identical; and in almost every alleged case of its importation into New Orleans, one or the other of those cities has been assigned as its source. If Havana have been accused more frequently than Vera Cruz, it was because of the greater amount of commercial intercourse, and the shorter time required for the voyage.

SECTION V.

KEY WEST.

The water shed or central swell of Florida, which, on the confines of Georgia, in the thirtieth parallel, has the altitude of one hundred and fifty or sixty feet, gradually subsides, and after passing the latitude of Tampa Bay, twenty-seven degrees thirty minutes north, is no longer obvious. ‡ Thence to Cape Sable, the southern extremity of the Peninsula, the surface continues to sink, and at that point, disappears beneath the sea. Its submergence, however, is imperfect, and to the south-west for nearly two hundred miles, there is a series of reefs and keys, || the most distant of which are the Tortugas, or Turtle Islands. The basis of this chain of shoals and low islands, is tertiary limestone, with superincumbent beds of sand, shells, and corals. In a hygienic, or medical point of view, there is but one of the whole series, which deserves attention, and that is —

Key West (Pl. I.), formerly called Thompson's Island. In position, this Island is about forty miles south-west of Cape Sable, the southern extremity of Florida, and between eighty and ninety north of Havana, with the Gulf Stream rolling between. It makes a part of the distinguished and dreaded Florida Reef, on which so many vessels have been wrecked. Its greatest

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* Norman: Rambles by Land and Water.

† Adventures in Mexico and the Rocky Mountains. By George F. Ruxton, Esq. 1848.

‡ Bradford's Illustrated Atlas, p. 139.

|| *Cayos, Rocks, Sp.*

length from east to west is seven miles, with an average breadth of two. Its elevation varies from that which permits an overflow by ordinary tides, up to ten feet; the greater portion, however, not rising above six or seven. The surface of the Island presents many marshes and shallow basins, filled during the rainy season with fresh water; which, although imbibing from the soil, or receiving from the spray of the Gulf, sufficient salt to render it brackish in the dryer portions of the year, is the most potable which can be obtained in the Island. The surface has a layer of soil supporting an herbaceous vegetation, and shaded by a growth of small trees and shrubs.* Seveeral years ago, Commander McIntosh, U. S. N., while stationed at Key West, had (as he informed me) a number of vistas cut through this jungle, along which he dug ditches, and allowed the tides to flow into the marshes, and the fresh water of the great rains to flow out; whereby the salubrity of the Island, as he believed, had been greatly increased.

Occasionally, the waves throw upon the shores of the Island an immense quantity of sea weed, enveloping mollusca and other marine animals; the decomposition of which, under the action of an almost tropical sun, adds greatly to the deleterious qualities of an atmosphere, already impure from more permanent causes.† These deposits are made under the influence of agitating winds, which are sometimes so violent as to drive the waves over the whole Island, and produce great devastation. The chief settlement of the Island is the town, harbor and military post of—

Key West, in N. Lat. 24° 33′ and W. Lon. 81° 52′. For a while, this was the principal naval station of the United States for the Gulf of Mexico. It has ever since been a military post. The inhabitants of the town consist largely of wreckers, or persons engaged in saving the crews and cargoes of vessels wrecked on the Florida Reef.

Yellow fever prevailed at this place, as an epidemic, at the time it was a naval station; but is not an annual visitant, as it is of Havana, ninety miles further south. According to the army returns, autumnal fever is not very prevalent. The average ratio of intermitting fever is twenty per cent. — of remitting fever two per cent.‡ It can scarcely be doubted that additional attention to the surface of the Island would render it, for a southern locality, highly salubrious.

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* Dr. Morgan: Phil. Jour. of the Med. and Phys. Sci. Vol. viii, p. 54.

† N. Amer Med. and Surg. Jour. Vol. iii, p. 24.

‡ Med. Statis. U. S. Army, 1840.

SECTION VI.

TAMPA BAY, AND FORT BROOKE.

Tampa Bay (*Pl. I*) extends in a north-east direction, about thirty-five miles into the peninsula of Florida. It bifurcates into heads; the larger of which, to the west, having no rivers, and being, as yet, nearly destitute of inhabitants, may be dismissed from further notice. The other receives the Alafia, an inconsiderable stream; and the river Hillsboro', which, at its mouth, is one hundred and thirty yards wide; though but a few miles up, it is so contracted, that a steamer can with difficulty turn in its channel.

There are oyster beds at its junction with the Bay, and, of course, no alluvial deposits. To the east, between it and the Alafia, there are some low wet grounds, and actual marshes; but its banks and the coast to its west, are dry and sufficiently elevated, bearing open forests of pine and scrubby oaks—the former predominating on its right bank, the latter on its left.*

Fort Brooke, N. Lat. 27° 57′ and W. Lon. 82° 35′, stands on the east bank of the estuary of Hillsboro' River.

It has been regarded as a highly salubrious post. Yellow fever has scarcely ever invaded it. The ratio of remittent fever is nine per cent.—that of intermittent, seventy-three per cent. The high ratio of the latter disease has not, however, destroyed the character of this post, with our army surgeons; who have observed that a large proportion of the cases were contracted elsewhere, when the troops were on detached service.†

Tampa Bay affords the best harbor south of Pensacola; and, since the termination of the Seminole war, settlements have begun upon its banks, which at no distant period may render it an eligible winter residence for invalids—the most southern to be found on the Peninsula of Florida.

SECTION VII.

PENSACOLA: THE BAY AND TOWN.

I. The beautiful Bay of Pensacola, in the state of Florida, is connected with the Gulf of Mexico, by a strait one mile in width, the greatest depth of which is twenty-four feet. The banks of this entrance consist of sand drifts, which rise but a few feet above the surface of the water.

That on the west side, separated from the main land by a shallow lagoon, is called Foster's Island; that of the opposite side, likewise separated by a

* Commander Johnston, U. S. N., and Dr. Holmes, U. S. A., MSS. *penes me.*

† Med. Statis. U. S. A., p. 296.

long, navigable sound, is called Santa Rosa Island. This island stretches off to the east for the distance of forty miles, being from one to two miles in width, and rising in some places to such a hight, that its white sands are visible to a considerable distance, and serve as beacons to the navigator. Its surface presents many little pools and marshes, abounding in shrubs and rattlesnakes, and is generally studded with tufts of a heath-like undershrub (*Ceratiola ericoides*), among which there are a few scattering and stunted pines and live oaks. Its whole outer beach is lashed by the waves and swells of the Gulf. Its opposite shore is separated from the continent, by Santa Rosa Sound, just mentioned, which opens into the Bay of Pensacola, about three miles from its mouth. From below the junction of the Sound, the Bay widens; yet one shore is everywhere distinctly visible from the other. On both sides a post-tertiary or tertiary plain, from twenty to eighty feet high, composed of yellowish sand above, and white sand beneath, approaches more or less closely to the margin of the Bay, and constitutes its banks. At the distance of about twenty miles inland, the Bay, like that of Tampa, terminates in two heads or subordinate bays.

The eastern, called St. Mary de Galves, has two small tributaries bearing the names of Yellow Water, and Black Water Rivers. The western, named Escambia, receives the waters of the river Escambia. The two former of these rivers, drain but a small tract of sterile country, and therefore throw into their receptacle a correspondingly limited quantity of silt. Their estuaries, however, are flanked with impenetrable cypress swamps, as may be seen by a reference to *Pl. III.* The Escambia, originating in the state of Alabama, where the soil is fertile, has brought down, and deposited in its portion of the bay, an extensive bed of alluvion, which is sufficiently elevated to support such trees, shrubs, and gramineous plants, as delight in subaquatic situations. Among the last, is a tall culmiferous grass (*Phragmites communis*), having perennial roots, but annual stems, which, by their luxuriant growth, and speedy decay, constantly add to the vegetable elements of these deposits of silt. Near its mouth, this river, like the others, is bordered with broad cypress swamps, which are terminated by higher post-tertiary deposits, bearing long-leaved pines. In the first twenty miles from the Gulf, that is to the place of bifurcation, the axis of Pensacola Bay is nearly northeast; but the prongs, or subordinate bays, turn to the north. In various places the shores are skirted with narrow salt marshes, and, around the heads of the Bay, especially between its divisions, there are extensive cypress swamps.

Viewed from any position, Pensacola Bay is an object of much natural beauty. Its pellucid waters, salt enough to abound in oyster beds, are encircled at their very edge with a narrow girdle of white sand, which harmonizes pleasantly with the foliage of the live oaks, magnolias, cypresses, hollies, and various flowering shrubs, which overshadow its margins, and

PL. III.

Face p. 50.

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relieve the somber back ground of long-leaved pine woods, which overshadow the higher terraces.

The medical, naval, and military histories of Pensacola Bay, are of equal interest with its scenery. The first merits great attention, from the national importance of the two latter. Constituting the only sheltered and capacious harbor on the northern semicircle of the Gulf, the Government has made this bay a naval station, and erected the various works necessary to its defense. At the entrance there are three fortifications: Fort Pickens, on the west end of Santa Rosa Island; Fort McCree, on the east end of Foster's island; and Fort Barrancas, a mile above, on more elevated ground. At the distance of another mile, on the same low sand ridge, stands the Naval Hospital; and a mile higher up the bay, on the same side, the Navy Yard. The road from one to the other of these establishments, passes over loose dunes of white and yellow sand, which, by the action of the winds, is continually drifted from place to place. These sands produce pines and other plants that flourish in such localites; but their recrements do not accumulate on the surface; for the soluble parts sink with the rain water into the loose strata beneath, and the insoluble are buried up by the action of the winds. Even the mold and manure, which are thrown upon the gardens attached to the Navy Yard, are speedily dissipated, and a surface, not unlike that of drifted snow, reäppears. Still, in the midst of these dunes, there are concavities in which accumulations of soil, or matters impervious to water, have been made, and thus pools or swales, bearing sub-aquatic shrubs and herbaceous plants, have been generated. They are, however, of limited extent. Above the Navy Yard, as may be seen on *Pl. III*, there are two bayous, bordered with salt marsh, and surrounded by dry and elevated pine terraces, presenting the site of the old Cantonment Clinch. Ten miles from the portals of the Bay, keeping still on its western side, stands the ancient—

II. Town of Pensacola, in N. Lat. 30° 28′ and W. Lon. 87° 12′. Its site is a level plain of blown sand, rising but a few feet above the surface of the water, and surrounded by the post-tertiary, pine-covered terrace, which every where environs the Bay. Between the town plat and this terrace, there is a narrow, semi-circular belt of swamp, originally covered with cypress trees, (*Cupressus disticha*), which have been replaced by a dense jungle of Titi bushes (*Mylocarium ligustrinum*). Numerous springs of soft water, the product of rain upon the adjacent plateau, discharge themselves into this swampy belt, the extremities of which are salt marshes, of limited extent. In the month of March, I found the heat of these springs as low as sixty-two degrees Fahrenheit; a temperature, which shows their origin to be superficial, and that they had been affected by the previous winter. By these springs the water of this paludal tract is kept pure; and by the compact Titi grove, the rays of the sun are prevented from acting on its surface.

Pensacola is an old town, and settlements near the outlet of the Bay were made before that of the town. Having belonged successively to Spain, France, England, and the United States, its population, improvements, and modes of living, offer a mixture of the whole. The houses, mostly of wood, are chiefly built in the Spanish and French styles, and scatteringly distributed over the plain.

Apart from the people of the town, the seamen of our national ships, the persons attached to the Navy Yard, and the small garrisons which man the different forts, the population of Pensacola Bay is but limited; for the surrounding country is, in general, too sterile for profitable agriculture. The densest population, beyond the limits of the town, is found near the mouth of Blackwater River.

The yellow fever has been several times prevalent in the town, among the shipping, and at the Navy Yard; but the number and malignity of its invasions bear no comparison to its severe visitations of Mobile and New Orleans.

Of autumnal intermittent and remittent fever, it will be proper to speak more extensively. From the forts to the town of Pensacola inclusive, (all on the west side of the Bay), although there are some swales and small swamps or ponds among the sand dunes, and some narrow tracts of salt marsh, there are, as we have seen, no deposits of silt; and the organic matters accumulated in the wet or paludal spots, are chiefly those which belong to the pine forest. Now the inhabitants of this range of coast have for a long time enjoyed an exemption from autumnal fever, remarkable for a southern locality. The town of Pensacola has even been resorted to as a summer residence by citizens of Mobile and New Orleans. When, however, we ascend the same coast, about ten miles above the town, to the estuary of the Escambia River, we find a state of things entirely different. The silt brought down by that stream, has filled, as we have seen, a large portion of the western head of the Bay, and thus generated a marsh, several miles in width, near which the settlers have been fatally scourged by autumnal fever; although they escaped yellow fever when it prevailed in the town and Navy Yard below. The medical history of this devoted locality dates back more than eighty years, as may be seen from the following narrative by Lind. *

"In the year 1766, sixteen French protestant families, consisting of sixty persons, were sent, at the expense of the English government, to West Florida. The ground allotted for their residence was on the side of a hill, surrounded with marshes, at the mouth of the river Scambia.† These new planters arrived in winter, and continued perfectly healthy until the sickly months, which in that country are those of July and August. About that time eight gentlemen (from one of whom I received this account) went to

* Essay on the Diseases Incidental to Europeans, in Hot Climates. By James Lind, M. D. Phil. Ed., 1811, p. 161.

† Escambia.

this new settlement to solicit votes for the election of a representative in the general assembly of the province; by remaining but one night, every one of them was seized with a violent intermitting fever, of which the candidate for becoming the representative, and another of their number, died. The next day seven other gentlemen came upon the same business to this unhealthy spot; but, by leaving it before night, they escaped the sickness, and all continued in perfect health. Among the French settlers, during these two months, the annual fever of the climate proved so fatal on this unwholesome spot, that of sixty persons fourteen only survived; and even those who remained alive, in the September and October following, were all in a very ill state of health; not one of them had escaped the attack of the fever, and most of them died within a few months afterward, from the injury it had done to their constitutions.''

No other settlement in this locality seems to have been attempted for a long time afterward. At length, in the year 1832 or 1833, a new attempt was made, by laying off a town, to be called Florida, on the eastern side of the estuary, in the edge of the pine woods; as may be seen by a reference to *Pl. III.* All the pine terraces of the south are proverbially free from autumnal fever; but here the pine lands lie to the leeward, while extensive silt marshes spread out to the windward. Between twenty and thirty wooden houses were built, and tenanted by as many families. Their history, as given me by Dr. Hulse, the intelligent and reliable surgeon of the Naval Hospital, and by Mr. Innerarity and Mr. Kelly, old and respectable citizens of Pensacola, may be told in a few words. Year after year, while the inhabitants of the coast below remained healthy, they were assailed by autumnal fevers of the most malignant character; the spot was at last called a "Graveyard;" and being abandoned by those who survived, I found, on passing through it in 1843, but two families remaining.

These well-ascertained facts have so important a bearing on the origin of autumnal fever, that I have considered them worthy of circumstantial detail. The heat and moisture of the lower and upper portions of this little Bay are the same; but while the former has only a few limited tracts of pine marsh, the latter includes extensive deposits of silt and organic matter; and to them, I think, we are bound to attribute the fatal insalubrity which has been described.

III. PERDIDO BAY is found a few miles west of that which has been described. Its coasts are composed of white sand, with copses of live oak. Its seclusion is very great; yet several naval officers have placed their families on its retired banks, near the Gulf, where they are said to spend the summer and autumn in perfect exemption from every form of fever. Such is the connection between a sandy surface, and a salubrious summer atmosphere.

SECTION VIII.

MOBILE BAY AND CITY.

I. MOBILE BAY (*Pl. IV*) is one of the largest, and decidedly the most regular in form, of any with which the northern coast of the Gulf of Mexico is indented. Its axis lies in the meridian. Its broad base is more than half cut through by a low, narrow, peninsular sand dune, which penetrates it on the eastern side, and, approaching Dauphin Island (another dune of white sand), narrows the entrance to a strait; immediately within which is the harbor — the water of the Bay being too shallow to permit the further ingress of ordinary ships. Near the Gulf, this Bay presents a broad expansion, but soon becomes much narrower by an approximation of its eastern to its western coast;—the latter continuing, nearly in a straight line, into the interior. This narrowing reduces it to twelve or fifteen miles; which breadth it retains nearly to its head. The banks on either side, are composed of post tertiary or tertiary sand and clay, of which the predominant colors are yellow, white, and red. The Bay receives but a single river, which, by several mouths, enters at its apex, having previously assumed its name. The constituent streams of this river have been indicated when treating of our hydrographical axes. They drain a region of country, chiefly in Alabama, equal in area to that state, or more than fifty thousand square miles; and hence, more water is thrown into this Bay, than into any other around the Gulf. The Coosa and Tallapoosa, uniting, form the Alabama; and the Tuscaloosa and Tombeckbee, joining, form a common trunk, which retains the name of the latter. As they flow on to the south, the Alabama and Tombeckbee gradually approach, and at length, about one hundred miles from the Gulf, mingle their waters, lose their name, and are called Mobile River. Their place of junction was, no doubt, once the head of Mobile Bay.* Thence to the head of the existing Bay, there is a series of low, alluvial islands, surrounded by river channels, known under the names Mobile, Tensaw, and Spanish River.

Two-thirds of the region which the river drains, is composed of loose or decomposable tertiary and cretaceous deposits, sufficiently fertile to support a luxuriant tree and herbaceous vegetation; and hence the supply of alluvion is inexhaustible. With these materials, organic and inorganic, the river has filled the upper part of the Bay; and is still carrying on a work, which has been already completed in the estuary of the Mississippi. When the driftwood and sand meet the tides of the Bay, they are lodged against the shores, or deposited on the bottom; but the argillaceous matter advances further toward the Gulf, and gives to the lower part of the Bay a bottom of mud, which is gradually diminishing the depth of its waters. Thus, at some indefinitely future period, the Bay will be filled up; after which, the Mobile, like the Mississippi River, will begin to project a peninsula, or cape, into

* Dr. Heustis: Amer. Jour. Med. and Phys. Sci., Vol. XIX, p. 68.

PL. IV.

Face p. 54.

C. A. Fuller U.S.C. Engr.

the Gulf. In these progressive changes, Mobile Bay differs widely from Tampa Bay, while the Bay of Pensacola is intermediate, as to condition, not less than locality.

In a generalizing comparison of the Mississippi, Mobile, Pensacola, and Tampa estuaries, we find that the ratio of filling up, has been according to the order in which they have been named; which, again, corresponds to the relative magnitude of the rivers which enter them, and the fertility and progressive elevation above the sea, of the regions which they drain. The shores of Mobile Bay are skirted with silt marshes and cypress swamps, beyond which the banks are more elevated than those around Pensacola Bay, and covered with pine and oak forests. In some places, the banks press closely on the waters of the Bay.

II. MOBILE, the commercial metropolis of the state of Alabama, and also of south-eastern Mississippi, is built near the present head of the Bay, on its western side, thirty miles from the Gulf, in N. Lat. 30° 41′ 48″, and W. Lon. 87° 59′. Its site is an ancient beach of the Bay, rising from the water's edge to the hight of eight or ten feet, and extending back to the post tertiary, or tertiary plain, at the distance of six or seven miles. The margin next the Bay, was originally overflowed by tides and waves, and consisted of river alluvion, imbedding the trunks of trees. Much of the site, which is somewhat terraced, like the river bottoms of the interior of the Great Valley, is sandy, with beds of clay beneath, which prevent the rains from sinking into the earth, and lead to the formation of swales, or marshy grounds, that require ditching before they can be cultivated. A well, dug at some distance from the Bay, but on the city plat, passed through yellow sand for sixteen feet, affording good water; but on descending a few feet deeper, a fetid mud, enveloping the trunks of trees, was reached, and the water was spoiled.* In another part of the city, a well was dug to the depth of twenty-five feet. It passed through strata of clay and sand, and then came to marsh mud, with the trunks and leaves of trees.†

To the south, adjoining the city, there is a cypress swamp, considerable portions of which are overflowed by the high tides of the Bay, or by the waves, when swells from the Gulf ascend it. The water of this swamp is chiefly supplied, however, by springs, which issue from the base of the neighboring sand terrace. The margin of the swamp rests on an immense deposit of silt and drift wood, which presents a foul and suspicious aspect. On the upper or north side of the city, and constituting to some degree its boundary, is a small bayou, called One Mile Creek; and beyond it another, named Three Mile Creek; designations which indicate their distances from the city. On each side of, and between these sluggish streams, there are swamps overshadowed with cypress, sweet-gum (*Liquidambar styraciflua*), magnolia, and other trees and shrubs, common in such localities of the South. These

* Dr. Gates. † Dr. Heustis: Amer. Jour.

swamps never become dry, even to the depth of two inches below the surface.*

In front of the city, the Bay abounds in islets and beds of alluvion, enveloping driftwood and covered with a heavy growth of reed grass (*Phragmites communis*), and other aquatic and sub-aquatic plants.

III. SPRING HILL, at the distance of six miles from the margin of the Bay, is the permanent residence of several families, and a place of retreat for the inhabitants of the city in seasons of yellow fever. This bluff is the eastern border of the pine terrace which surrounds the Bay, the waters of which, no doubt, once overspread the lower plain to this bluff. Its elevation is something more than one hundred feet. Several copious springs, which I found in the month of April to have the temperature of sixty-eight degrees, Fahrenheit, issue from this escarpment. One of them, by an under-ground hydraulic system, is made to supply the city; the water of the Bay being too brackish for domestic use. Derived from the rains which fall on the terrace behind, the water of this and other springs which I examined, appears to contain nothing but a trace of muriate of soda. As the citizens of Mobile, and especially its recent immigrants, look to this spot as a place of escape from danger, during the yellow fever months, I may be excused for adding, that a natural curiosity exists in the neighborhood, a visit to which may relieve the tedium of an anxious exile from the city.

IV. THE THUNDERING SPRING. About eight miles west south-west of Spring Hill, the road passing through a forest of long-leafed pine, is the fountain to which this name is applied. It boils up, in the edge of a valley two or three hundred yards wide, with such copiousness as to form a considerable brook. The water is transparent, but throws up a quantity of yellowish sand, which, in part deposited around, has formed a sort of crater. A pole can be thrust down about ten feet, when it strikes a rock; which, judging from quarries in the neighborhood, must be a soft, tertiary sand stone. The temperature of this spring, in the month of April, was sixty-nine degrees, Fahrenheit; its mineral impregnation, the same as that at Spring Hill. No gas of any kind escapes. The name which this fountain has received, was suggested by a remarkable peculiarity. A subterranean sound, like that of low, distant, and muttering thunder, is distinctly heard, at short but not regular or rhythmical intervals. On applying my ear to the trunk of a neighboring tree, this thundering, or earthquake-sound, was not only louder, but I heard a *constant* sound, resembling that produced by holding a finger in the ear; and which every now and then was augmented to the rumbling which has been described. Some very susceptible persons affirm, that they can, by their feet, feel a slight vibration of the ground. The radius of the sound is so limited, as to indicate that the peculiar movement of the waters, or some other agency which occasions it, is not far below the

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* Dr. Lewis: New Orleans Med. Jour., Vol. I, p. 282.

surface. Some efforts have been made to add this place to Spring Hill, as a summer resort; but the desire of those who retreat from the epidemics of the city, is, to remain so near as to receive early intelligence from those whom they have left behind, and, as yet, it has not been much frequented. About two hundred yards below this spring, on the same level, there is another which emits no sound. Its temperature is one degree less.

V. INHABITANTS.—A settlement was commenced on Mobile Bay, by the French, about the year 1700. In 1712, Homans published a map, which presents Fort Louis, near or on the spot where the city now stands.* From that time, until the cession of Louisiana to the United States, in 1803, Mobile was occupied either by the French or Spaniards. For many years after the cession, it attracted but little notice, and continued to be a rude and unimportant village; but about the year 1825, it began to fix the attention of the people of the northern states of the Union; and in twenty years became a city of eight or ten thousand inhabitants; consisting chiefly of Americans, the French and Spaniards having mostly left it. The new houses, nearly all of wood, are built in the fashion of other American towns, though many of the old habitations are interspersed among them. The streets are paved with semi-fossilized shells, chiefly the *Rangia cyrenoides;* which are found in long, low beds near the city, as also in various other places around the Gulf, at the elevation of a few feet above the highest tides.†

Next to New Orleans, Mobile has suffered more from yellow fever than any other town north of Havana and Tampico. As might be expected from its topography, faithfully represented in *Pl. IV*, autumnal fever, both intermittent and remittent, of every type and grade of violence, is an annual visitant; and frequently imposes on the yellow fever a certain degree of periodicity. It is not, of course, limited to the city; but appears, with even greater intensity, among the people of the surrounding alluvial plain, and on the foul margins of the Bay, both above and below the city. The inhabitants of the neighboring pine woods remain exempt.

SECTION IX.

MINOR BAYS.

Between Mobile and New Orleans, there are three small Bays (*Pl. V*), which deserve the attention of the medical topographer; as they are places of refuge for the people of those cities during the prevalence of epidemics; and resorts for sea bathing, not only for those citizens, but the people of the interior. They are defended from the Gulf by a series of islands, which stretch

* Darby's Louisiana, p. 316. † Conrad.

directly west from the mouth of Mobile Bay, under the names of Dauphin, Petit Bois, Round, Horn, Dog, Ship, and Cat; between which and the main land there is water of sufficient depth for small steamers.

I. PASCAGOULA BAY.—This is the most eastern. It receives, on its west side, the waters of Pascagoula River, which drains the ten or twelve south eastern counties of the state of Mississippi, and some of the adjoining parts of Alabama. Being an alluvial stream, it has made extensive deposits in its estuary, and reaches the Bay by two mouths, which are separated and skirted by low alluvial grounds and small lakes. On the opposite coast of the Bay, there are likewise marshes and lagoons. Between them, to the east, stands the old French village of Pascagoula, now Krebbsville; and near the junction of the river with the Bay, there are modern residences, with an extensive hotel, having places for sea bathing in front. These settlements are on higher and dryer banks, which, at their base, present a fillet of white sand, in beautiful contrast with the waters of the Bay.*

The French settlement on this Bay, was among the first on the northern shores of the Gulf of Mexico, and dates back to the early part of the eighteenth century. As Doctor Fearn, of Mobile, has informed me, it is seldom visited by yellow fever; and being but little infested even with autumnal fevers, has become a place of summer retreat for the people of that city.

II. BAY OF BILOXI.—To the shores of the Bay of Biloxi belongs the distinction of having received the first immigrants to Louisiana. The settlement was begun by the French, in the month of May, 1699.†

I am indebted to the distinguished Dr. Samuel A. Cartwright, of Natchez, for an account of this locality, at which he spent several months. The Bay is in front of an arm or prong of Pascagoula Sound, with which it has a connection, as may be seen on *Pl. V*, about fifteen miles west of Pascagoula Bay. From its mouth, Biloxi Bay projects inland to the north-west, with an average width of two miles, until it attains the length of twelve or fourteen. The villas or settlements called Biloxi, are situated on the peninsula or tongue of land between Pascagoula Sound and this inlet, which, in their rear, is (locally) called Back Bay. This peninsula is about two miles wide and nine long. Its surface is sandy and sterile, with a narrow strip of lower and richer soil. There are no marshes, however, between the Sound and Back Bay; but on the farther or continental side of the Bay, there are fresh water swamps. Three streams or bayous enter the Bay on that side; all of which are deep and narrow. The Peninsula of Biloxi, is a place of sojourn for the people of New Orleans, during the prevalence of yellow fever,

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* Besancon's Annual Register, p. 150.

† Bancroft's Hist. of the Col. of the U. S. Vol. III, p. 201.

but it has not always remained exempt from that epidemic. Autumnal fever, however, scarcely ever invades it.

III. Bay of St. Louis.—This beautiful little Bay lies west of Biloxi. I have not the materials for a description, but may state, in general terms, that the Pine Woods approach the Gulf shore to its east; and that it receives the waters of two small rivers, the Jourdain and the Wolf. Near the entrance of the Bay, on its eastern side, is Pass Christian, and on its western, Shieldsboro'; both of which are summer retreats for the people of Mobile and New Orleans, especially of the latter. This indicates, that it has been found a salubrious locality; yet, more than once, it has been invaded by yellow fever. Its liability to autumnal fever appears to be small.

SECTION X.

THE PINE WOODS.

The medical topography of a country would be incomplete, if it did not comprehend specimens of its healthy localities along with the sickly; as it is by comparing them, that we arrive at a knowledge of the influence of topographical conditions, under the same climates. If the low and alluvial or marshy tracts, around this part of the Gulf, are infested with autumnal and yellow fevers, there is an adjacent plain, the hight and composition of which, give it a decided character of salubrity. This tertiary or post-tertiary deposit of sea sand and clay, has been already referred to in the descriptions of Pensacola and Mobile. It borders the north-eastern segment of the Gulf, from Lake Pontchartrain, or rather from the delta of the Mississippi to Pensacola; and consequently lies in the rear of all the places which have been described. Between the city of Mobile and Pensacola, its altitude is one hundred and fifteen or twenty feet; but further back from the coast, it rises higher. The rivers which flow through it to the Gulf, are the Perdido, between Pensacola and Mobile, and the Pascagoula and Pearl, between the latter and Lake Pontchartrain; all of which are edged with swamps, overshadowed with cypress, sweet gum, and other semi-aquatic trees; decorated with a somber drapery of long moss (*Tillandsia usneoides*). The prevailing and characteristic forest tree of this plain, is the long-leafed pine; which, in many parts, as between Pensacola and Mobile, forms a dense and lofty forest, to the exclusion of almost every other tree. Straight, and generally destitute of limbs to a great hight, these pines present to the eye a vast system of intercolumniation, which, seen at night, by the running fire that occasionally consumes their shed cones and long leaves, with the dry grass among which they have fallen, presents a grand and striking spectacle. This conflagration is one cause why so little *humus*, or mold, accumulates on the surface; another is that but little mold is generated by the *exuviæ* of a pine forest, and hence the surface remains barren. Where the plain is too level for the water to flow off, it has collected in small basins, and favored the growth of a more varied vegetation, the remains of which have contributed to arrest its descent into the earth; and thus, in the midst of the pine desert, the eye is relieved by oases of flowering shrubs and annual plants, from which rivulets are seen to flow and congregate into larger streams. In descending from the plain, they readily cut channels through its loose strata; from which there likewise issue copious springs of pure water, the quality of which has been already given, when speaking of the Pensacola and Mobile fountains.

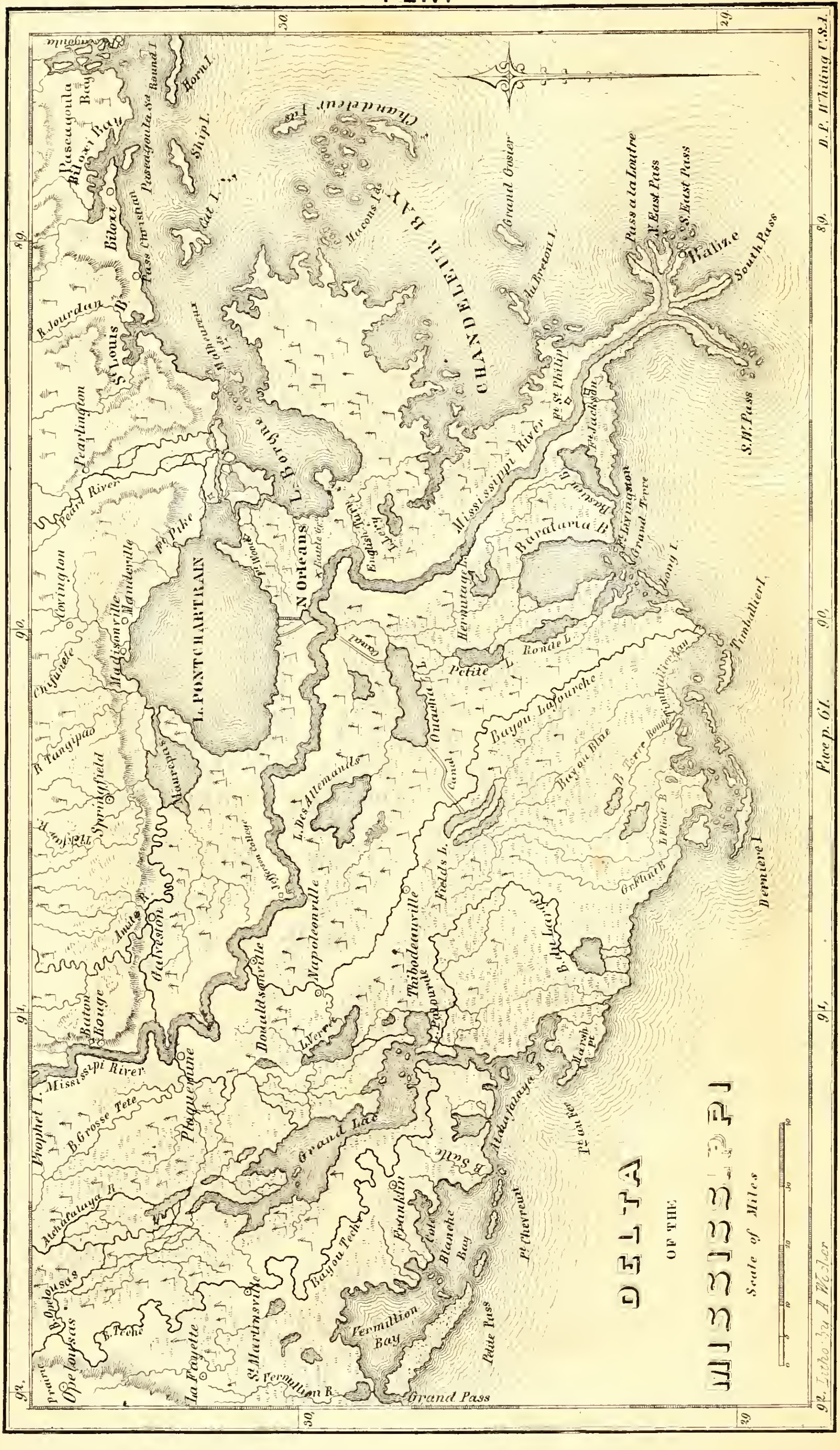
Such are the celebrated *Pine Woods*, to the protecting influence of which the people of New Orleans and Mobile commit themselves for safety, in yellow fever seasons; expecting to enjoy an equal immunity from intermittents and remittents. Thus, in the region we are describing, the sweet gum and cypress, with their festoons of moss, are the symbols of deep soil, foul surface, impure water, vegetable decomposition, and fevers; while the long-leafed pine, symbolizes sterility, dryness of surface, gushing springs of pure water, and sound health.

CHAPTER IV.

THE SOUTHERN BASIN, CONTINUED.

THE DELTA OF THE MISSISSIPPI—CONSIDERED AS A PART OF THE GULF COAST.

It is impossible to give an intelligible account of the Delta of the Mississippi, which must forever constitute the most important part of the coast of the Gulf of Mexico, without frequent references to the river above. This may sometimes carry us far into the interior; but such eccentricities are unavoidable, unless we had begun the analysis of the Southern Basin, with a description of the river itself, instead of the Gulf; which would, in the end, have involved us in greater difficulties. Our aim, in fact, is not to describe the Great Interior Valley, but to develop, before the reader, those physical conditions, which may be presumed to exercise an influence, either directly or indirectly, on health; and the same method is not adapted to both objects.


DELTA
OF THE
MISSISSIPPI
Scale of Miles
Face p. 61.
D. P. Whiting U.S.A.
Litho by A Weber
L. PONTCHARTRAIN
N. Orleans
L. Borgne
CHANDELEUR BAY
Chandeleur Ins
Mississippi River
Balize
South Pass
S.W. Pass
S. East Pass
N. East Pass
Pass a la Loutre
Grand Gosier
Ship I.
Cat I.
Horn I.
Round I.
Pascagoula Bay
Biloxi Bay
Biloxi
Pass Christian
St. Louis B.
R. Jourdan
Pearlington
Pearl River
Covington
Madisonville
Mandeville
Ft. Pike
Maurepas
R. Tangipao
Springfield
Amite R.
Galveston
Baton Rouge
Plaquemine
Donaldsonville
Napoleonville
Thibodeauxville
L. Des Allemands
Barataria B.
Bayou Lafourche
Bayou Blue
Grand Lac
Atchafalaya R.
Atchafalaya B.
Bayou Teche
Franklin
Cote Blanche Bay
Vermillion Bay
Vermillion R.
St. Martinsville
La Fayette
Opelousas
Grand Pass
Petite Pass
Pt. Chevreuil
Marsh Pt.
Timballier I.
Derniere I.
Long I.
Grand Terre
Ft. Livingston
Ft. Jackson
Ft. St. Philip
La Breton I.
Macons Is.
Prophet I.
B. Grosse Tete
Petite L.
Ronde L.
Ouacha L.
Fields L.
L. Verret
Canal

SECTION I.

DESCRIPTIVE HYDROGRAPHY.

The axis of the Delta of the Mississippi (*Pl. V*), lies nearly south-east and north west from the Balize, or junction of the North East Pass with the Gulf of Mexico, to the mouth of Red River; a distance, following the meanders of the stream, of three hundred and forty miles.* In latitude, these extremities differ about two degrees — in longitude, nearly three. On the west, the Delta is bounded by the diluvial plains of Opelousas — on the east, by the tertiary, or post-tertiary highlands of West and East Feliciana, and of Baton Rouge; which, having closely approached the river, recede from it after passing that town, and trending to the east, pass round Lake Maurepas, Lake Pontchartrain, and Lake Borgne, to the Gulf of Mexico, at the Bay of St. Louis; thus including those lakes within the Delta. That they *do*, in fact, belong to it, is rendered certain, by the discharge of a portion of the waters of the Mississippi through the Iberville — a bayou which leaves the river a few miles below Baton Rouge, and joining the River Amité, after its descent from the plateau just mentioned, flows into Lake Maurepas; and thence, by the Bayou Manchac, into Pontchartrain, which is connected with Lake Borgne and the Gulf, by channels that meander among the Rigolets at the mouth of Pearl River. The water of these lakes, or, more properly, bays, is shallow and brackish; and they can be regarded in no other light, than as portions of the Gulf, partly filled up with silt, carried into them from the Mississippi by the Iberville, Amité, and Pearl Rivers. Within the historic period, the Iberville has conveyed but a moderate quantity of water; and of course the deposits from that source have latterly been small. Whether it did not formerly discharge a more copious stream, cannot be known. For the distance of one hundred and forty miles, the Mississippi, before a levee was constructed, poured over its left bank, during its annual swells, a great quantity of water, which finally made its way into the lakes just mentioned, and by its deposits must have contributed to their filling up. The prevention of this overflow by art, has thus diminished to some extent the ratio of deposition in the lakes, and prolonged indefinitely the process of their transformation into dry land. At present, the tract between them and the river, varying in width from five to twenty-four miles, is a cypress swamp, with ponds which are nearly on a level with the lakes. Much of it, however, in autumn, becomes dry land; and most of it is sufficiently elevated to admit of being reclaimed by adequate ditching and draining. South of Lake Borgne, down to Chandeleur Bay, there is, however, an extensive tract, (extending from the left bank of the Mississippi), which is permanently terraqueous, and mostly irreclaimable.

That portion of the Delta which lies south-west of the Mississippi, is larger,

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* Nicollet: Hydrograph. Basin.

and its hydrography much more intricate. Its *general* surface is everywhere below that of the waters which flow through, or rest upon it, when their great fountain, the Mississippi, is swollen. Hence most of it is uninhabited; and presents an indescribable labyrinth of lakes, ponds, bayous, swamps, and shaking prairies; much of which, however, by early autumn, becomes so dry as even to oppose an obstacle to its cultivation. The waters which replenish this system of natural canals and reservoirs, are derived from two sources: *first*, the streams which descend from the plateau of Opelousas on the west, and the bottom lands of Red River on the north; *second*, the bayous, or lateral outlets of the Mississippi, which are three in number. The largest and uppermost, is the Atchafalaya, which leaves the Mississippi only three miles below the mouth of Red River, and, in the opinion of Mr. Darby,* was once the bed of the latter river. The descent of this bayou, at first, is rapid, and its course nearly south; while that of the Mississippi, after the separation, is south-east; and hence they diverge from each other. One hundred and twenty miles below, the main river sends out Bayou Plaquemine, which runs nearly west, until it joins a branch of the Atchafalaya. Thus reinforced, that bayou, when its parent stream is swollen, assumes the aspect of a large river. As it winds its way to the south-south-east, on a plain which declines gently to the south-south-west, it discharges a great quantity of water over its right bank, and sends off lateral bayous, which connect it with the Teche, with Lake Chetimaches, or Grand Lake, and with several smaller lakes; while it pours a deep inundation over many extensive swamps. Before reaching the Gulf, at the distance (following its meanders) of nearly two hundred miles, it enters the lower end of Lake Chetimaches, on issuing from which, it receives the Bayou Teche; whence both, in a single channel, flow on to Berwick's Bay, an arm of the Bay of Atchafalaya. There is, as yet, but little cultivation on the banks of the Atchafalaya and still less on those of the lake with which it is so intimately connected; for the entire area around that large reservoir, is subject to deep annual inundation. When the Mississippi is low, the current in the Atchafalaya and Teche is very slack, and the tides flow up them to a great distance.

The position of the Teche is west of the Atchafalaya, and its general course nearly parallel to that bayou. It skirts the plains of Opelousas, and traverses the parish of Attakapas, having lateral connections in its upper part, with the Atchafalaya, of which the principal is the Bayou Courtableau, through which, however, it does not, at present, receive much water.

In the opinion of Mr. Darby, a part of Red River once flowed in the Teche — a theory which may explain why its waters no longer rise to the level of its banks. This beautiful natural canal forms the south-western water boundary of the Delta.

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* Geographical Description of the State of Louisiana, 1817.

Let us return to the Mississippi. At Donaldsonville, twenty-four miles below Bayou Plaquemine, and eighty above New Orleans, is the efflux of Bayou La Fourche, the last of any considerable size, sent off by the great river. The course of this bayou is at first south, and then south-west, to the Gulf, between Barataria and the Timballier Bays. Its length, sinuosities, and complications, are much less than those of the Atchafalaya. The entire tract between these two bayous is subject to deep, yearly submersion. That between the La Fourche and the Mississippi, in the direction of New Orleans, abounds in streams which originate within the delta, and in ponds and lakes, of which the largest is Barataria.

From this rapid hydrographical sketch, it will be seen that the Delta, west and south of the Mississippi, is a true terraqueous region, the greater portion of which is annually inundated; while in the neighborhood of the Gulf, there are large tracts of permanent salt marsh. The perfect silence and deep solitude of many parts of this peculiar region, are described by Mr. Darby as profoundly impressive. *

The remaining hydrographical description need not detain us long. We begin with the Mississippi, at the head of the Delta, and follow it to the Gulf. On both sides, an artificial levee, or earth embankment, raises the banks of the river three or four feet above their original hight, (which was previously greater than that of the swamps behind), and thus prevents the escape of any considerable quantity of water, except when a crevice is accidentally formed. On the outside of this embankment, lies the cleared and cultivated land, which may average a mile in width, and declines gradually to the cypress swamps in the rear. The depth of water in these swamps, varies from a few inches, to ponds and lagoons of several feet. In the spring and early summer, they are all flush; but before the following winter, extensive tracts of swamp have become dry land, to be again inundated.

Some plantations are so level, that the rains, and the water which percolates the banks or escapes by small crevices in the levee, when the river is swollen, will not flow off to the swamps. Ditches, intersecting each other at right angles, are then required, to receive and conduct it to the levee, through which it is discharged into the Mississippi, by steam power. The machinery for this purpose, is modeled after the paddle-wheels of our steam boats. Being placed in the ditch where it passes through the levee, the rotation of the wheel drives the water forward; this creates a depression, into which that behind, of course, immediately flows; and thus a current is established through the principal ditch, by which all connected with it are emptied.

As the voyager traverses the Delta, he finds a monotonous sameness in the natural scenery, which, however, contrasts agreeably with that of the interior

* In the foregoing sketch I have preferred to follow our distinguished Physical Geographer, Mr. Darby, rather than any more recent authority; on account of his well-known accuracy, and his having written from personal observation.

of the Valley. There he looks *up* to behold it—here he looks *down;* there he sees streams running *into* the river—here he sees them flowing *out; there* his horizon is *limited*—here it is *boundless;* there *diversity* of objects enables him to estimate his progress—here *uniformity* gives him the feeling of moving in an eddy. An equal sameness prevails in the subjects of cultivation on the banks; so that almost the only source of variety, is in the style of the old French and new American plantations, as they appear in succession.

Passing by New Orleans, which is one hundred and four miles from the junction of the Mississippi with the Gulf, the voyager, at the distance of fifty or sixty miles below the city, finds himself on a kind of peninsular cape, which projects boldly but obliquely into the Gulf; with Chandeleur Bay on his left, and Bastian Bay on his right. The banks have become much lower, and the belts of arable land narrower; at length, through some natural or artificial opening, he catches a momentary glance of the green waters of the Gulf. Further on, the banks sink nearly to the level of the salt water, and the swamps, with a diminished number of trees, begin to crowd hard upon the river; which, after having given off numerous small bayous, divides, about twenty miles from its termination in the Gulf, into three channels, and thus presents a subordinate and more limited delta. These channels are called the *South West Pass*, the *South Pass*, and the *North East Pass;* the last of which, at the distance of seven or eight miles from the Gulf, sends off, northerly, the *Pass a la Loutre;* and in the opposite direction, the little *Bayou*, on which stands that old pilot's emporium, the BALIZE; finally, the main trunk divides, before reaching the Gulf, and while one branch retains the name of *North East*, the other is called the *South East Pass*. The interest which attaches to this extreme point of the Delta, requires that a Section should be specifically appropriated to it.

SECTION II.

RISE AND FALL OF THE LOWER MISSISSIPPI.

In conformity to the general law, that as we descend great rivers to the sea, the range between high and low water diminishes, we find that of the Mississippi much greater above than within its Delta.

The following TABLE shows this range at several points from Natchez to the Gulf:

Localities.	Distance from the Gulf.	Range from low to high water.
Natchez,	406 Miles.	52 Feet. *
Baton Rouge,	244 "	30 "
Donaldsonville,	187 "	25 " †
New Orleans,	104 "	14 "
Balize,	2 "	3 "
Cincinnati, on the Ohio River,	1548 "	63 "

* Nicollet.—Too much, I suspect. † Darby.

Not having data for the Mississippi above Natchez, I have added the range from low to high water at Cincinnati, on the Ohio river.

At first view, it might be supposed, that the longer the range between high and low water, the greater is the overflow of the banks; but the reverse is the fact; for the inundations become deeper, and of more frequent occurrence as we descend; and but for the levees, the whole Delta would be deeply submerged every spring and summer.

While the rivers, which, by their union, make up the Mississippi, rise and fall several times in the course of every year, that river, within the Delta, has generally but one rise and one fall; that is, a maximum which it slowly attains, and a minimum to which it sinks as gradually. This will appear from the following TABLE:*

MONTHLY RECESSION OF THE MISSISSIPPI FROM HIGH WATER MARK AT NEW ORLEANS: AVERAGE OF THE CALENDAR YEARS, 1833, 1834, 1835, AND 1836.

January,	7.90 Feet.	July,	5.82 Feet.
February,	5.13 "	August,	7.97 "
March,	4.27 "	September,	13.10 "
April,	2.94 "	October,	13.33 "
May,	4.67 "	November,	12.34 "
June,	4.72 "	December,	8.84 "

We are here presented with a gradual fall from April to October, and as gradual a rise through the remaining five months.

The greatest flood cannot often occur as early as March, as the rivers of the north have not then broken up; and it does not always happen in April. Thus, in 1843, I found the maximum in June; and in 1844, in July. In these instances, however, extraordinary rains had reinforced the usual spring floods.

The sustained elevation from February to July, results from the progressive opening of spring, beginning in the low latitudes of Red River, the Arkansas, and the Tennessee, and extending, with the advance of spring, to the sources of the Mississippi proper, and the Missouri, in latitudes forty-seven and forty-eight degrees. If the Mississippi flowed to the east or west, its vernal rise would be more rapid, more elevated, and of shorter duration. After the subsidence commences, less and less water, of course, flows into its bayous, or oozes through its banks; and, as that which has been effused drains off into the Gulf, large tracts, as already mentioned, are laid bare, and at length, under the burning sun of July, August, and September, are dried until they crack open;—thus passing, in the course of two months, from a saturated condition to the opposite extreme.

* Barton, in Historical Notice of New Orleans, p. 290, 1849.

SECTION III.

DEPTH OF THE LOWER MISSISSIPPI.

In advancing from the interior to the Gulf, the volume of the river increases far more in a vertical, than in a horizontal direction. Indeed, its width above the mouth of the Missouri, is often quite as great as below the mouth of Red River, the last of its tributaries. Within the Delta, its depth becomes so great, that bars and islands are nearly unknown; and snags are almost as rare, except along its banks. Accurate soundings have not, however, been made at many points. According to Mr. Darby,* an admeasurement taken nine miles below the efflux of Bayou La Fourche, and one hundred and seventy-five from the river's mouth, gave a depth of one hundred and fifty feet beneath high water mark. At New Orleans, Mr. Albert Stein, Civil Engineer,† and Professor Riddell, of the Medical College of Louisiana,‡ have made soundings; which gave, respectively, one hundred and fifty, and one hundred and forty-two feet; but in 1844, several gentlemen and myself sounded opposite the city, and unexpectedly found a depth of two hundred and forty feet. There might have been some error in the experiment; nevertheless, I was informed by Captain Whiting, U. S. A., that certain officers of the army, in sounding opposite the Barracks, three miles below the city, found a pool of still greater depth. Of the soundings from this point to the division into three Passes, twenty miles from the Gulf, I cannot speak. In the South West Pass, Mr. Stein found the average depth sixty-eight feet; the greatest, eighty; the least, fifty-four. Near the outlet or bar, it was twenty-two; on the bar, as low as fifteen, and even thirteen feet four inches. The South Pass is much shallower; and the North East Pass is also not so deep as the South West.

Assuming one of the lowest soundings opposite the city — one hundred and fifty feet — as the basis of a calculation, and deducting therefrom ten feet for the fall of the river from the city to the Gulf, and fifteen feet for the depth of water at the South West Pass, we find that the bottom, at that Pass, is one hundred and twenty-five feet higher than the bottom opposite the city; and that, consequently, the water at the bottom in front of the city must ascend that hight before it can surmount the bars and reach the Gulf, or else it constitutes an eddying pool.

The fall of the surface of the Mississippi, at low water, through that part of the Delta which extends from its vertex at Red River to New Orleans, is sixty-five feet; which, divided by the distance — two hundred and thirty-six miles — is equal to three inches and three-tenths per mile. Below the city to the Gulf, the fall is one inch and two-tenths. Thus, the farther the Delta

* Description of La., p. 65.

† Documents on the Navigation of the Mississippi River, p. 47

‡ Commercial Review of the South West. Vol. II, p. 437.

advances into the Gulf, the greater is its horizontality, and, consequently, the slower its current. From experiments made at New Orleans, Professor Riddell and Mr. Stein have been led to fix on two feet per second as an average velocity for all stages of water.

SECTION IV.

TEMPERATURE OF THE RIVER.

Several circumstances influence the temperature of rivers: *First.* A stream largely supplied from springs, will be warmer in winter and cooler in summer, than its banks beneath the surface, or the air resting upon it. *Second.* A shallow river is much sooner brought to the temperature of the earth's surface, and that of the air, than a deeper one. *Third.* An alluvial and turbid river will, *cæteris paribus*, be more heated by the sun than one which is transparent; as it is by impinging on solid and opaque bodies, that the sun's rays develop caloric; while, at the same time, its bed will radiate less heat than if its waters were clear. *Fourth.* When a river descends rapidly upon a plain, its waters will be cooler than those of another river of the same volume originating on the plain. *Fifth.* When one river flows nearly under a parallel of latitude, and another in the meridian, the former will have the temperature proper to the latitude, while the latter, if it flows from the north, will be colder, having that which is the mean of all the latitudes it has passed through. Thus, as I have several times observed, the Ohio, which flows nearly west, is two degrees warmer than the Mississippi, which descends from the north, both being examined near their junction. To the west of the Mississippi, the Arkansas, the Kansas, and the Platte, like the Ohio, flow nearly under the parallels in which they originate; but the Missouri and Upper Mississippi originate in high latitudes, and descend to the south. In reference to the Delta, the whole are northern. If we assume two miles an hour for the average velocity of the river, as it traverses the Delta three hundred and forty miles, that portion of the river bed empties itself, and is filled with cooler water from the north, every seven days. To enable us to estimate the effect of this circulation on the climate of the Delta, we must ascertain both the area of the river's surface, and its actual temperature. The former may be obtained without much uncertainty. Taking its length, from the mouth of Red River to the Balize at three hundred and forty miles, and its breadth at half a mile, we have one hundred and seventy square miles as its area; but to this we may safely add thirty, for the area of the greater bayous, giving two hundred square miles of river surface within the Delta. The latter *desideratum*—the annual temperature of this water—presents a greater difficulty. It has not, indeed, been ascertained; at least, I have not met with the requisite observations. On the 24th of February, 1843, I found the temperature of the water flowing into the Gulf over the bar of the South West, or deepest Pass, to be forty-two and a half degrees; while that of the Gulf, a few miles out, was fifty-six and a half, or fourteen degrees higher. On the 1st of March, the temperature in the middle of the North East Pass, opposite the Balize, was likewise forty-two and a half degrees; and on the 5th, that at Fort Jackson, thirty miles above, was the same. On the 11th of the same month, the temperature of Lake Pontchartrain was fifty-six, and of Lake Borgne fifty-five — average fifty-five and a half, or thirteen degrees higher. The difference of a degree between these lakes and the Gulf, doubtless arose from their higher latitudes. These were probably minimum winter temperatures; and they indicate, as a general average, a difference of thirteen and a half degrees between the waters arriving from the north, and those sojourning in the Gulf, on which the base of the Delta rests. I did not, however, find an equal difference in summer. On the 5th of June, of the same year, the temperature of Lake Pontchartrain was seventy-eight; that of the Mississippi within the Delta, on the 7th, was seventy-two—difference six degrees. This date was too early by almost two months, to give the highest summer heat. On the corresponding day of 1846, Professor Riddell * found the heat to be seventy-five, or three degrees greater. His observations, continued, at short intervals, from the 21st of May to the 12th of August, show a gradual rise from seventy-two degrees at the first date, to eighty-five on the 1st of August; after which the temperature declined. The mean of his observations from the 12th of July to the 12th of August — eighty-three degrees — may, perhaps, be received as the *maximum* summer temperature of the river, in that year, at New Orleans. Opposite the same city, in February, 1843, the *minimum* was forty-one degrees. The mean of these numbers, sixty-two degrees, may, in the absence of better data, be received as the annual temperature of the river as it passes by the city, and it is several degrees below the atmospheric mean. Thus, observation confirms the *a priori* conclusion, that the Mississippi acts as a cooler to the banks and the atmosphere of its Delta; and when we recollect that it meanders through that region, until its surface amounts to two hundred square miles, that its trough is replenished every seven days, and that nearly all population and all cultivation are on its immediate banks, from which the water is abstracting caloric and transporting it to the Gulf, we seem called upon to believe, that its climatic influence ought not to be overlooked. This, however, is far from being equal throughout the year; for, as it depends on the quantity of water, it is, of course, least in the latter part of summer and in early autumn, when the river is low; and we find, in fact, that its temperature then rises to the mean heat of the atmosphere. Thus the extremes of winter and summer, are greater in the river than in the atmosphere of the Delta; and the difference results from depression of

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* Com. Rev. of the South West, Vol. II, p. 436.

the former in winter and spring, or rather for the first half of the calendar year.

But it is not by its temperature only, that the Mississippi acts upon the climate of its Delta. During its annual flood, which continues from March to July, there is a constant infiltration into the banks, and an inundation, as we have seen, of large portions of the Delta. As this water has a temperature below the mean heat of the ground which it penetrates, or the surface which it overflows, some degree of refrigerating effect may be attributed to it; but a greater effect results from the evaporation in June, July, August, and September, which, of necessity, prevents the sun from heating the surface of the ground to as high a temperature as it would otherwise attain. This evaporation, moreover, maintains the humidity and freshness of the air. In conclusion, it may be said that, while the river floods, in March and April, lend their influence to the production of occasional cooler days and rawer winds, than would otherwise occur, they assist, in May and June, in giving to the banks a climate whose deliciousness is equaled only by its salubrity.

It would be interesting to know the mean annual temperature of the river at the different parallels which it traverses, for the purpose of comparing it with the mean atmospheric temperature; but observations to this end have not yet been made. I will, however, state a few which go to show the difference between two distant points, at nearly the same time, in two seasons of the year. On the 7th of June, 1843, the river being very high, its temperature near Bayou Sara, within the Delta, was seventy-three degrees, and on the 10th, near Cairo, about nine hundred miles above, it was seventy; showing that it had only acquired one degree of heat, for every three hundred miles. On the 10th of February of the same year, when the river was not so high, I had found it, at the upper of these stations, thirty-four degrees, and at the lower, forty-two, indicating an increment of heat nearly three times as great as in the month of June. The difference in latitude between the stations is a little more than six degrees. So that, in summer, a flow through two degrees of latitude was necessary to the acquisition of one degree of temperature; but in winter, a degree of latitude gave one degree thirty-three hundredths of heat. It deserves to be added, that in the latter experiment, the temperature continued substantially the same to the Balize; though both the distance by the river and the difference in latitude were sufficient, if the ratio of increase had continued the same, to have raised it nearly two degrees. The small change of level may have been one cause of this constancy; but the facts are too few to warrant a generalization, or to develop the ratio of increased temperature, from diminished latitude and reduced elevation above the level of the Gulf.

SECTION V.

SUSPENDED AND DISSOLVED MATERIALS OF THE RIVER.

I. It will aid us in studying the medical geology of the Delta, to pass in review the materials which the river draws to itself from the countries which it drains; for all its deposits, however modified or mingled, are thence obtained and transmitted to its estuary.

1. As may be said of every other river, the waters which constitute the Mississippi are derived from the atmosphere, and reach its trough directly by flowing on the surface, or indirectly from under the surface, through which they have descended to burst out in the form of springs. We shall hereafter see, that the rains which fall within the basin of the Mississippi, are chiefly derived from the Gulf of Mexico; and thus the river is but the return to that reservoir of what had been given out. That portion of its water which flows from the surface, is not from rains alone, for nearly all the subordinate rivers, which unite in forming the main trunk, originate in latitudes or at elevations above the sea, in which deep snows annually fall; and hence the spring floods are composed largely of snow water.

Within the basin of the Mississippi, we have, as was shown in *Chapter I.* almost every kind of geological formation; and thus our springs and smaller streams throw into the river all the saline ingredients which water, as it flows among, or cuts through, various strata, is capable of dissolving. Of the whole, bicarbonate of lime and muriate of soda are undoubtedly the most abundant; but the former, from mere exposure and agitation, is in part decomposed and deposited before it reaches the Delta. The latter, however, continues in solution, and even increases in quantity, as the current advances; as Red River and the Arkansas, especially the former, afford, when low, a water so impregnated with salt as sometimes to impart a brackish taste.*

2. The suspension of inorganic matter is immensely beyond its solution; and this again, from the variety of our mineral strata, may be as diversified as that of any other river. In centuries indefinitely past (the diluvial period), when mighty torrents traversed the continent from north to south, they no doubt rolled before them a great amount of solid matter in fragments too large to be suspended; and strata of pebble stones and gravel, in all probability, lie deeply buried up in the Delta; but at present, solid mineral matters are transported to it by suspension only. These are chiefly alumina or clay, and silicious and calcareous sand, very finely comminuted. Of these, and other suspended mineral matters, it is only the most finely powdered that reach the Delta, the coarser being deposited by the way; and hence, in descending the river from any point above, we observe a regular decrease of the larger *debris* of rocks, and a corresponding, proportional in-

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* Darby's View of the United States, p. 317.

crease of the smaller; — the highest degree of comminution being seen in those portions of the Delta which project farthest into the Gulf. Of the clays thus carried down, some are blue, others yellow, and others red. The last is chiefly from the river which bears that name. Those furnished by the Ohio, are always of some shade of yellow; those from the Missouri, are bluish.

3. The vegetable kingdom contributes largely to the mass of transported materials.

a. The forests on every tributary send down trees, and the Mississippi is perpetually uprooting the groves of cotton wood, and other trees; for the growth of which, it had not only deposited the soil, but sown the seed. In its progress, this driftwood becomes gradually stripped of its bark and branches, and all its soluble parts dissolve in the water. Much of it is deposited by the way, and much is towed to the shore after it reaches the Delta; yet not a little is deposited in the salt marshes of the Balize, or floated off on the surface of the Gulf.

b. The autumnal contribution of forest leaves and luxuriant annual plants. is very great; and from their levity, many of them reach the Delta; having in their progress given out to the water all their soluble elements.

c. The drainings of swamps and marshes, holding in solution whatever the water has found to dissolve, must not be overlooked.

4. The animal kingdom throws in a liberal contribution. Every tributary deep enough to float a carcase, is from time to time required to bear it off; and many animals of various sizes, which have perished on their banks, are uplifted by their floods, and borne away to the common trough. Still further, most of the trees and plants, whether green or in decay, which find their way into the river, take with them the worms and insects in which they abound.

5. All our cities and larger towns are on the Mississippi and its great tributaries. Their population cannot fall far short of a million; and the ordinary dependence of the whole is on their rivers, to receive the contents of the private and public sewers, and the drains from all establishments of industry. Thus a civic contribution — organic and inorganic, soluble and insoluble — is perpetually going forward.

6. The recrements from more than four hundred steamers, and twice or thrice as many flat boats, make an element of impurity not to be passed unnoticed; nor should we overlook the discharge into the river of the ashes, abounding in saline ingredients, which are produced by the daily combustion of many thousand cords of wood.

7. Finally: The water of the Mississippi abounds in *microscopic infusoria.* This was first announced, I think, by Professor Bailey, of the United States Military Academy, in February, 1845.* In a specimen of water

* Proceedings of the Boston Society of Natural History.

taken from the river opposite St. Louis, he detected no less than twenty species, all living and active, a part of them soft, and a part with hard, silicious shells. Most of the species were in great numbers.

II. Such are the elements, organic and inorganic, living and dead, with which the Mississippi becomes freighted in its transit down the Interior Valley. The catalogue is rather startling; but before we decide against the purity of its waters, we must recollect a few facts. *First.* Their immense volume. *Second.* The subsidence in their eddies of a great deal of matter, which cannot, from its weight, be borne up without a rapid current. *Third.* The disintegrating and decomposing power of water, and the readiness with which gases, the product of decomposition, escape from running streams. *Fourth.* The fact, that when the river is low, and the heat of the latter part of summer in the south is great, the proportion of foreign ingredients is much less, than during the floods of spring and summer.

In a series of experiments, by Professor Riddell, continued from the 25th of May, when the river was within two feet of its greatest altitude at New Orleans, until the 10th of August, when it was but eighteen inches above low water mark, the proportion of suspended matter gradually lessened to one-third. At the beginning, the heat of the river was seventy-three degrees — at the end, eighty-three degrees. Thus, the *maximum* of both atmospheric and river heat in the Delta, coincides with the *minimum* of river impurity. If this fact have no bearing on the question of salubrity, when the water is used as a beverage, its connection with the production of gases is obvious, and well fitted to show, that in the season when fevers — ascribed to the presence of gases — are prevalent in the Delta, the material supplied by the river for their development, is greatly reduced, by diminution in both the volume of water, and the proportion of foreign ingredients.

III. The salubrity of the Mississippi water, or that of the Missouri, which imparts the character of turbidness, is not an open question. From St. Louis to New Orleans, the testimony of the population on its banks, and of those who spend a great part of their lives upon it as watermen, is unequivocally in its favor. Many persons drink it before its suspended materials have subsided, and seem to prefer it to that which has been rendered transparent by time or art. That it produces some effects on the system, which transparent water, from wells and springs, and our other rivers, does not, is an established popular opinion. It is even regarded by many persons as being, to a certain extent, medicinal, and especially adapted to the cure of chronic functional disorders of the stomach, bowels, and liver — an opinion in which I am disposed to concur. That its daily use averts some forms of disease, may be admitted as probable; but precise observations on all these points are wanting; and I shall dismiss the subject with the presentation of two facts, in which, I trust, the reader will take a pleasant interest. *First:* Professor Bailey, after observing its numerous shoals of microscopic animalcules, expresses the opinion, that they are sufficiently abundant to render the water somewhat *nutritious*. *Second:* In his Letters on Louisiana, written in the year 1751, Captain Boissu informs us, that the Mississippi water has the property of contributing to the *"fecondite des femmes!"*

SECTION VI.

GEOLOGICAL AGE, DEPTH, GROWTH, STRUCTURE, AND CHEMICAL COMPOSITION OF THE DELTA.

The Delta, from its bottom up, is, of course, a newer formation than the marine deposits which are seen along its northern border above Baton Rouge; such deposits having been formed before the Mississippi existed, or the continent was raised from the sea. But of the *actual* age of the Delta, on the scale of ordinary chronology, nothing is known. Before the banks of the river were surmounted with levees, every year spread new deposits over their surface, and over the Delta generally; and had the ratio of annual growth been then noted, and could the depth of the reservoir thus filled up be ascertained, the problem of *time* might be solved. In the absence of such data, recourse has been had to the quantity of silt annually brought down by the river, and an assumed depth of the basin filled up; relying for the latter, on soundings in the Gulf beyond the line of river deposits. But to give even approximative exactness to this method, the river above the Bayou Atchafalaya should be gauged at every stage of water, and the velocity of the current determined for every elevation; this being done, and the proportions of silt correspondingly ascertained, an important part of the data for a computation would be obtained. The depth of the bay which has been filled would, however, still remain a desideratum; and the question, whether, in the period which immediately succeeded the elevation of the continent, the ratio of filling up was not much higher than at the present time, would require to be answered. When the great currents, to which reference has been repeatedly made, swept over the Interior Valley from north to south, the filling up of the long arm of the Gulf, which penetrated the continent as it is now penetrated by a similar arm from the Gulf of St. Lawrence, doubtless went on with great rapidity. To this end, the loose tertiary and cretaceous deposits on both sides of the ancient estuary, no doubt contributed a full share.

Happily the question of the rate at which the Delta has been deposited, is not of importance to the medical geologist; but he *is* interested in knowing the amount and composition of the suspended matter of the river, and, also the composition of the mud of the Delta itself.

In the month of April, 1838, Mr. Stein, at New Orleans, found the proportion of suspended matter to be $\frac{1}{1400}$ in bulk, or about $\frac{1}{700}$ in weight.

In the year 1844, the river being at a mean hight, I took up from near its middle, on the 31st of March, a bottle of water, eight hundred and sixty miles above New Orleans; on the 3d of April, another, four hundred miles lower down; and on the 10th, a third, opposite the city. These bottles remained closely corked until the 15th of May, when they were opened at the laboratory of Professor Riddell. On being uncorked, each emitted a sulphurous smell. By evaporation, we ascertained that the proportion of silt, by weight, of the first, was $\frac{1}{1190}$ — of the second, $\frac{1}{1250}$ — of the third, $\frac{1}{1350}$; seeming to indicate a regular decrease on descending the river.

But the most important, and, indeed, the only series of experiments, are those made by Professor Riddell, from the 25th of May to the 13th of August, 1846.* They show, *First*, That while the river continues at the same hight, the quantity of silt may vary. Thus, for the first month after he began to experiment, the river being within three feet of high water mark, it did not vary more than a foot; and yet the amount of sediment varied to the extent of a third, and even a half. This is, no doubt, attributable to the predominance at different times of the water of different tributary rivers; and nearly connected with this is the fact, that in the summer, after the river has fallen to the mean hight of the year, the proportion of silt may be even greater than before. Thus, on the 3d of July, when, by gradual subsidence, the hight was only five feet seven inches above the lowest stage which occurred during his experiments, the quantity of silt was greater than at any previous period, even when the river was three feet nine inches higher. *Second*. His table also proves that, in the latter part of July, and thence forward, when the stage of low water is rapidly approaching, the proportion of silt is signally reduced, becoming at length not more than one-third of what it was in the period of high water. *Third*. As an average of all his experiments he obtained $\frac{1}{1158}$, by weight, of solid matter.

Let us turn to the composition of the silt while suspended in the river, and after its deposit in the Delta. This, of course, must be forever varying in quality, as we have seen it varies in quantity. Thus when several tributaries are swollen at the same time, the suspended matters will be different from those poured into the great trough by the freshet of any one of them; and again, each will supply a silt of a kind varying in some respects from every other.

In the month of June, 1844, when the river, at St. Louis, about twelve hundred miles from its mouth, was of mean hight and rising, I took up a quantity of water at a distance from the shore, the sediment of which was analyzed by Doctor C. H. Raymond, a skillful practical chemist, of Cincinnati, who obtained from one hundred parts the following results —

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* Com. Rev. of the South West, Vol. II, p. 435.

Silica, - - - - - - - - -	48.00
Alumina, - - - - - - - - -	18.50
Oxide of iron, - - - - - - - -	14.00
Carbonate of lime, - - - - - - -	8.00
Phosphates of alumina and iron, - - -	1.00
Vegetable mold, or geine, - - - - - -	3.00
Undecomposed organic matter, - - - -	7.50
	* 100.00

Desirous of knowing what elements were dissolved in the same water, I desired Dr. Raymond to analyze a portion of that which had passed through the filter; which he did, and obtained the following results, from one hundred parts—

Sulphate of soda, with a trace of the chlorides of lime and magnesia,	67.55
Organic matter, with a trace of silica, - - - -	32.45
	100.00

We may, I suppose, assume that this organic matter, with traces of silica, consisted largely of the tribes of microscopic animalcules, discovered by Professor Bailey.

We are indebted to Professor Riddell for analysis of the mud of the Delta, at New Orleans. It was taken from the river's bank, and after being dried by a heat of two hundred and twelve degrees Fahrenheit, gave the following results—

Silica, - - - - -	74.15	Phosphoric acid, - -	0.44
Alumina, - - - - -	9.14	Sulphuric acid, - - -	0.07
Oxide of iron, - - - -	4.56	Carbonic acid, - - -	0.74
Lime, - - - - -	2 08	Chlorine, - - - - -	0·01
Magnesia, - - - -	1.52	Water, - - - - -	3.12
Manganese, - - - -	0.04	Organic matter, - - -	3.10
Potassa, amount not determined,		Loss, - - - - - -	1.03
Soda, " "		Total	100.00

The silt obtained in these and all other experiments of a like kind, is the chief material of which the Delta is composed, at least in its more recent and superficial parts; but there is imbedded in it whatever solid matters may have been floated down and lodged in the estuary; which, of course, are chiefly the trunks and branches of trees and the bones of animals. Moreover, as the sea was always present, resisting, as it were, the encroachments of the land, we may suppose that marine exuviæ are present to a greater or less degree.

The *well-water* obtained in such a heterogeneous deposit, cannot, of

* NOTE, BY DR. RAYMOND.—In this analysis all the precipitates were dried to 212° Fahrenheit; at this temperature the alumina, oxide of iron, and carbonate of lime would retain water equal to about one-half of their weight.

course, be very pure. Professor Riddell* has examined that afforded in the month of September, when the river was low, by a well, ten feet deep, in New Orleans. Under evaporation, it left a residium of solid matter equal to a twelve hundredth part, by weight, of the water employed; but, in the month of December, the proportion was augmented to a ten hundred and ninety-fourth. This residue was of an olive color, and imparted a sharp taste. Examined with the microscope, nearly one-fourth appeared to consist of organized matters, such as the sporules, or germs of algæ, and animalcules with their ova. The mineral ingredient proved to be —

Bicarbonate of lime,
Bicarbonate of iron,
Muriate of lime,
Muriate of magnesia,
Muriate of soda.

Being within six miles of Lake Pontchartrain, this well had perhaps been reached by percolation from that body of salt water, and was not, therefore, a fair representative of the wells of the Delta generally; nevertheless, they must everywhere afford water abounding in impurities.

Wherever examination can be made, as along the river and in some excavations by art, it is seen that these materials have been deposited in horizontal layers. I may refer to two perforations as instructive in regard to the geological structure and composition of the Delta. *First.* Professor Riddell informs us, on the authority of M. W. Hoffman, Esq., that north of New Orleans, near Lake Pontchartrain, in the year 1828, Mr. Harvey Elkins bored to the depth of two hundred and seven feet. Thirty feet below the surface, fragments of Indian pottery were brought up; and part of a deer's horn, recent shells, and bones of land animals, were occasionally raised. The stratum in which the boring was stopped, consisted of a hard, blue silicious clay. Brackish water, with volumes of some kind of gas, arose.†

Second. In the year 1844, I visited two gas tanks, each sixty feet in diameter, and sixteen feet deep, recently sunk in the back part of the city; and received from the intelligent superintendent, Doctor Rogers, an account of what was met with in excavating them. At first, they encountered soil and soft river mud; then, harder laminated blue alluvion; then, deep-black mold, resting on wet, bluish quicksand, so moveable that they could not proceed further. On this the brick walls of the tanks were laid, and the sinking under their weight was so unequal as to produce curves in the ranges of brick, which, of course, were at first horizontal. A pile of brick laid in the center of one tank, caused the center of the adjacent tank to bulge up. The roots, and bases or stumps, of no less than four successive growths of trees, apparently cypress, were found standing at different elevations. The first had a diam-

* Hist. Notice of New Orleans, 1840. † Com. Rev. of the S. W.

eter of two feet six inches; the second, of six feet; the third, of four feet; and the fourth, of twelve feet at a short distance up, with a base of twenty-eight feet for the roots. It was imbedded in a soft, deep-black mold. When cut with the spade, much of this wood resembled cheese in texture, but hardened on drying. This statement was confirmed by Mr. Kelvy, who conducted the excavation. At the depths of seven and sixteen feet, burnt wood was met with. No shells, or bones of land animals, or fish, were observed; but in a tank previously excavated, at the depth of sixteen feet, the skeleton of a man was found. The cranium lay between the roots of a tree, and was in tolerable preservation, but most of the other bones crumbled on exposure. A small *os ilium*, which I saw, indicated the male sex. A low and narrow forehead, moderate facial angle, and prominent, widely separated cheek bones, seemed to prove it of the same race with our present Indians. No charcoal, ashes, or ornaments of any kind, were found around it. In the bottoms of the tanks there was a constant boiling up of brackish water, varying in temperature in different fountains, from eighty to eighty-two degrees—the observation being made on the 3d of May. As this temperature approached much nearer to that of Lake Pontchartrain than the Mississippi, it showed, not less than the brackish taste of the water, the subterranean influence of the Lake, although at the distance of four or five miles from its margin.

On examining this water in the Laboratory of Professor Riddell, we found in it a liberal quantity of muriate of soda, with some muriate of magnesia, and a trace of muriate of lime; no sulphuric acid or iron was present. Along with the water there was a constant evolution of gas, which proved to be carburetted hydrogen.

In these excavations, no fragments of rock or rolled pebbles were encountered; and none are found in the banks of the river, or on the surface generally.

The coarse sands of the Missouri, found also in the Mississippi for many hundred miles below the junction of those rivers, are not met with here, as only the very finest can be suspended long enough to reach the Delta. Nevertheless, it is more silicious than a casual inspection would lead us to suppose.

SECTION VII.

VEGETATION.

I. The native tree and shrub vegetation of the Delta is composed of such species as delight in a warm, rich, and wet soil. None are so aquatic as to flourish in deep water, but many grow in swamps which are never dry. The Liquidambar everywhere abounds. The Cypress, equally abundant, enjoys the unenviable distinction of giving its name to every swamp; but is, at the same time, endowed beyond every other tree with a garniture of the long moss, which is to be met with everywhere as we ascend the river, until we pass beyond the Delta, up to the latitude of thirty-three degrees thirty minutes. The Live Oak (*Quercus virens*), prefering the sandier and dryer soils, is found from the shores of the Gulf to the thirty-third degree of latitude. The *Magnolia grandiflora* shows the same preference, and is found in nearly the same latitudes. The Sassafras grows to great dimensions. The Pecan (*Carya olivaformis*) shows, by the size and excellence of its fruit, that this locality is more congenial to it than that of Illinois. The single-seeded Honey Locust (*Gleditschia monosperma*) to a great degree replaces the *Gleditschia triacanthos* ; the *Celtis crassifolia* represents the Hackberry (*Celtis occidentalis*) ; while the two Buckeyes of the interior (*Æsculus*), the Papaw (*Anona*), and the Sugar Maple are wanting. The Cotton Tree and Sycamore, less conspicuous than in the interior, nearly disappear in the southern part of the Delta ; but on the other hand, the Elder (*Sambucus*), which is without an erect trunk in the colder climates, here becomes a small tree ; and the *Bignonia radicans* (Trumpet flower), and *Smilax laurifolia*, climb to the greatest hight. The native Cane (*Miegia macrosperma*) rises to a gigantic hight where deep and prolonged inundations do not occur; The *Chamærops serrulata*, or Fan-Palm, called Palmetto by the people, the *Sabal adansoni*, or small Fan-Palm, and Black Willows (*Salix*) of a large size, take its place. As we descend the narrow cape which projects into the Gulf and sinks nearly to its level, most of the trees which have been named disappear, leaving the last three in undiminished vigor. Down to the lowest extremity of this tongue of new land, tufts of Mistletoe (*Viscum album*), seen as far north as the fortieth degree, continue to show themselves ; and remind the voyager of the upland forests of the interior, when no other familiar object meets his eye.

The plan of this work does not permit, or demand, a more extended notice of the native Sylva of this region ; and I shall conclude with the remark, that the great current which transports and deposits the soil of the continent in the Gulf, also brings down the seeds of the forest trees generally. Many perish in the heat and moisture of the new locality, but many others germinate and flourish ; and thus the catalogue common to the two regions might be much augmented, if this were an occasion which required it.

II. In further illustration of the climatic and topographical condition of the Delta, it may be proper to notice a few of its cultivated exotics. Its first staple was Rice, which is still cultivated above and below Fort Jackson, midway between New Orleans and the Balize. Indigo was once successfully cultivated, but is now neglected. Cotton flourished well, but has been almost superseded by Sugar Cane, the northern limit of which is about thirty degrees thirty minutes. The Peach tree grows and bears luxuriantly, but the Apple finds the soil and climate too warm for the growth and ripening of its fruit. The Orange bears the open air as far north as the Sugar

Cane, but at that point is liable to be destroyed by the frost, and its fruit is sour: on the neck of land below New Orleans, the climate is more congenial to it, and the fruit is sweet. The Fig tree attains to its greatest hight, and bears a delicious fruit. The Grapes of the interior do not succeed; and Wheat cannot be cultivated.

SECTION VIII.

SALUTARY INFLUENCE OF THE JUSSIEUA GRANDIFLORA.

The Delta, from the latitude of New Orleans down to the Gulf, and west of the city, to its termination on the further side of Bayou Teche, has much uniformity of physical character. It abounds in lakes, from Barataria near the city, to Chetimaches beyond the Atchafalaya; and is traversed by a great number of small bayous, in addition to the larger enumerated in the first Section of this Chapter. It includes the fine and flourishing settlements of the La Fourche, the Teche, and the Attakapas, all of which appear to be as little affected with autumnal or yellow fever as the Mississippi coast above the city. Doctor Cartwright, of Natchez,* has ascribed this exemption to the influence of a plant, the name of which stands at the head of this Section. I propose to transcribe so much of this paper as will present his views, and thereby promote further inquiry. After a brief topographical outline, he proceeds: —

"Nearly the whole surface of many of the bayous, and a considerable surface of many of the lakes, in all that part of Louisiana below thirty degrees of latitude, are covered, in a greater or less degree, with the Jussieua grandiflora, the plant which possesses hygienic or health-preserving properties. Besides the Jussieua grandiflora, I observe a considerable number of other aquatic plants, both phænogamous as well as cryptogamous. Among the aquatic plants were the *Callitriche aquatica*, or water star grass; the *Lemma minor*, or Dutch meat; the *Riccia natans*, or floating liverwort; the *Nympha cærulia*, with its broad leaves; the *Isnardia palustris*, with its grass-like leaves; besides the *Rafflesia arnoldia; Lemnochæris humboltii;* the *Hydrocotyle vulgaris;* and a few others. On the bays, the *Fucus natans*, or gulf weed, was very common. Nearly all the aquatic plants, with the exception of the Jussieua grandiflora, the Lemna minor, and the Fucus natans, had more or less attachments to the soil by means of roots. The Fucas natans was only found in salt water. The Lemna minor is a very small and insignificant plant. The Jussieua grandiflora, however, is exclusively aquatic. It is a large flowering plant, which grows three or four feet above the surface of the water, and gives the water on which it grows the fallacious appear-

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* Western Journal of Medicine and Surgery (Louisville), Vol. I, p. 428.

ance of a natural meadow. The root is several feet in length; is jointed; about half an inch in diameter; lies horizontally on the water, but an inch or two below its surface. Each joint sends up the culm or stem of the plant; and around each joint of the root, at the foot of the stem, are a great number of radicles, or hair-like roots, some of which float on the surface of the water, and others dip down toward the bottom, or fasten themselves to old logs. These radicles, or little roots, often have adhering to them an inky kind of paste or substance, which is collected from the water, and no doubt constitutes the nourishment or proper aliment of the plant to which they belong. The roots, radicles and radicle leaves of the Jussieua grandiflora, form such a dense covering to the water, as to constitute a bridge sufficiently strong to enable snakes and grasshoppers to cross over the stagnant pools in which it grows. I traveled forty miles in a canoe through bayous and lakes which were almost entirely covered by the Jussieua grandiflora, intermixed with a number of other aquatic plants. I was often unable to see any water at all, except in the track made by the canoe. Although very frail, and easily pushed aside or broken, this floating plant afforded considerable resistance to the progress of the canoe. On the wide bays and lakes, the winds often detach large masses of this and other aquatic plants, which being driven about by the waves, and one detachment forced upon another, constitute what are called *floating islands*—which are often strong enough to bear the weight of a man in a recumbent posture. The Jussieua grandiflora, together with the other aquatic plants mentioned, we not only found on the lakes, bays and bayous, but they constitute the substratum of that singular and nondescript species of savannah called the *prairie tremblant*. These prairies are constituted, in the first instance, of a vast assemblage of aquatic plants. On this vegetable stratum, intermixed with the debris of their vegetable substances, a number of grasses and terrestrial plants, like parisites, fasten themselves and grow. The whole is formed into a complete vegetable matress, strong enough to support a man in a crawling position, but not sufficiently firm to enable him to walk upright. It is also too firm to admit the passage of a canoe. When the foot is placed upon it, the whole mass trembles; hence the French name *prairie tremblant*, and the English name *shaking prairie*. It is said, that if a hole is cut in it, fish may be caught with a hook and line.

"The facts on which I rest the hygienic, or health-preserving properties of the Jussieua grandiflora are —

"*First*. That it purifies all stagnant water in which it grows.

"*Second*. The remarkable exemption of the inhabitants of that section of Louisiana from malarious or miasmatic diseases.

"1. The water on which the Jussieua grandiflora grows, differs essentially from other water, similarly circumstanced, where this plant does not grow. Although I visited the country in which the plant is indigenous during a very dry and hot season, in the month of June, I found the stagnant water of the lakes and bayous inhabited by this plant, as pure to the sight, taste, and smell, as if it had just fallen from the clouds. Near the Gulf of Mexico, however, the water of the bayous was impregnated with salt. The water also of Bayou Black, although fresh, had a darkish appearance — owing to a chemical affinity between some ferruginous matter in the soil, and the oak trees and leaves which had fallen into the water. The water of Bayou Black, although of a dark color, was free from any disagreeable taste or smell. It contained no green scum, and was considered to be equally as good and palatable as cistern water, except near the Gulf, where the water is impregnated with salt. The inhabitants who reside on the margins of the stagnant lakes and bayous of that part of Louisiana, drink no other kind of water.

"I could discover no other cause for the remarkable purity of the stagnant water in the lagoons, swamps, lakes, and bayous of lower Louisiana, than the aquatic plant under consideration.

"North of the region where the Jussieua grandiflora flourishes, there is the same kind of alluvial soil, formed by depositions of the identical rivers which form the soil of Lower Louisiana; yet stagnant water, in hot weather, becomes exceedingly impure, beyond the limits in which the plant under consideration is found. The soil, therefore, cannot occasion the purity of the water of Lower Louisiana, because the same kind of soil, a little further north, has not the same effect. Nor can the purity of the water be owing to the salt or sea water; because the water is equally pure, wherever the aquatic plant grows, whether in salt water or fresh.

"I think it may be fairly inferred, therefore, that the aquatic plant known by botanists under the name of Jussieua grandiflora, consumes or feeds upon those substances which in other situations corrupt and vitiate stagnant waters in a warm climate.

"2. The remarkable health and longevity of the inhabitants, and their exemption from malarious and miasmatic diseases. The fact, that the region of country in which this aquatic plant abounds is exceedingly healthy, can be established beyond cavil or dispute. It nevertheless contains more stagnant water and swamps, than any other inhabited district of the same extent in the United States.

"The country immediately north of the line bounding the growth of the floating plant (which is about the thirtieth degree of north latitude), like that south of the thirtieth, is alluvial, contains lakes, swamps, and stagnant waters — is covered with nearly the same vegetable productions; but its atmosphere is evidently insalubrious, its stagnant waters impure, its inhabitants sickly, and human life of short duration; while the country of the aquatic plant, immediately south of it, contains a wholesome atmosphere, pure water, healthy, and long-lived inhabitants. It may be supposed that this country is too new and too thinly inhabited to enable us to form any correct estimation of the health and longevity of its inhabitants. Such a supposition is erroneous. Although a considerable part of the region abounding in the aquatic plant is uncultivated and almost uninhabited, yet a very considerable portion of this territory has been settled nearly a century. A large colony from Nova Scotia emigrated to it before the revolutionary war. Some of the settlements south of New Orleans contain more free white inhabitants to the square mile, than the oldest and most populous settlement in Pennsylvania.

"It may be said that the inhabitants are the descendants of French and Spanish, and consequently no just comparison can be drawn between them and the descendants of the English. It is true that a large portion of the inhabitants are of French extraction. A large settlement of them on the La Fourche, within this region, were born north of the United States, in the cold latitude of Canada. Colonel Sparks, an intelligent planter, who resides on Bayou La Fourche, in the midst of the colony which emigrated from Nova Scotia more than half a century ago, informed me, in 1831, that a great number of the emigrants were still living. He took me to a number of their houses, and his statements were confirmed by the inhabitants themselves. I saw more than a sufficient number of gray heads, and healthy looking children, to remove all skepticism in reference to the health and longevity of its inhabitants. Besides the French population, this particular section of country has spread through it a number of Italians, Spanish, Dutch, German, Irish, English, and Scotch. It also contains emigrants from almost every state in the Union. The negro population is also considerable, and is remarkably healthy and long-lived. It contains more negroes over one hundred years of age, than five New England states put together, including the whole population, white and black. The population of this land of aquatic plants, owes its origin to so many different nations, that it is not uncommon for the Creoles, or natives of the country, even when uneducated, to speak with great ease three or four different languages. If it were true, which it is not, that the French people are exempt from miasmatic diseases, such as bilious, remittent, and intermittent fevers, it would prove nothing; because the Germans, Spanish, Italians, Scotch, Irish, and English, together with the negroes and emigrants from the states north of Louisiana, are all, in this land of aquatic plants, singularly exempt from such diseases. But neither the French nor any other race of people are thus exempt, when they cross the line which terminates the growth of the floating plant. It is, therefore, a fair inference, that this plant, by consuming the impurities of the stagnant waters, prevents the generation of miasmata, and thus acts as a prophylactic against bilious fevers, and other miasmatic diseases.

"I am aware, that the inhabitants of the country themselves attribute their peculiar healthfulness to the influence of sea breezes. Out of the region of the floating plant, sea breezes, however refreshing and beneficial to some constitutions, have not been found to exert a prophylactic power in preventing miasmatic diseases. It is not probable that the sea breezes would do more good for the sea-coast of Louisiana, than for the sea-coast of Georgia, Carolina, Virginia, and Maryland.

"In the summer of 1831, I traveled extensively through Lower Louisiana, and am fully convinced, from what I saw and heard, that the particular district of country in which the floating plant abounds is preëminently healthy, while those sections of the State, similarly situated, but where the aquatic plant was not found, are grievously afflicted with malarious diseases.

"I visited, among others, the plantation of M. Rochelle, on a small bayou, near Berwick's Bay. The dwelling-houses stood on the high ground about a quarter of a mile from the bayou. The space between the bayou and the houses was occupied by a swamp, through which a canal had been cut to afford access to the high ground or bluff, on which the dwellings stood. M. Rochelle, a few years previously, had the trees covering the swamp in front of the houses cut down, in order to gain a better view of the bayou, and obtain a freer circulation of air. As I passed up the canal or ditch, through the swamp, I perceived, on each side, the decaying timber lying in the water, which was entirely stagnant. In many places the water was not sufficient to cover the ground. On ascending the bluff and looking around, I ascertained, that besides a swamp of a quarter of a mile in width, and three miles in length, in front of the plantation, there was an immense swamp in the rear, running back to a *prairie tremblant;* and on the lower side of the plantation was another bayou of stagnant water, and on the upper side a thick forest and cane-brake. I thought, at the time, that if the country contained a sickly spot, this was one. The Jussieua grandiflora, however, grew in profusion in all the waters around, whether these waters were in the bayous, or in the swamps; and whether they had communication with the bayous, or were isolated stagnant pools, they were found to be pure and transparent — free from any offensive taste or smell.

"M. Rochelle had fifty-three negroes living on this plantation, and his white family consisted of about a dozen persons. He informed me, that himself, and all the family, white and black, except the younger children, were natives of Rockingham county, Virginia — that he had resided on the plantation with this large family nine years, during which time no death had occurred, either among the whites or blacks, young or old — that there had not been more than three or four cases of sickness during any year — that these cases were slight, and required little or no medical treatment. His neighbors confirmed this statement, and gave nearly as good an account of themselves. The negroes with whom I met all looked healthy, happy, and contented.

"The next evening I put up at a house containing about twenty white persons and no negroes. The patriarch of the family was a Kentuckian by birth. He married a Spanish woman, who, dying, left him a widower with several children. He afterward married a French widow with two or three children, whose former husband was a German. The children by the last marriage as well as by the former marriages, together with a few aunts and other relatives, swelled the whole family to about twenty. No less than four languages, English, Spanish, German, and French, were spoken by the same family, living under the same roof. I got two of the sons of the old gentleman by his first wife, to take me in a canoe up Bayou Black. They were with me several days, and, as they spoke four languages, were of great use in enabling me to collect information respecting this country, inhabited by the floating plant and polyglot people.

"If I have been misinformed in reference to the health of this section of the country, there also are great numbers, in and about this city, deceived in this respect equally with myself. Numbers of people, in and about Natchez, have visited this region of country; some have removed to it; a few have been living in it for years. All with whom I have conversed, concur in the same opinion of its healthfulness. It is true, they differ in regard to the *causes* of its singular salubrity; some ascribing it to the proximity of the sea, and the sea breezes; others, to the large open prairies on its western border, in and near that part of it called Attakapas, without recollecting, that the inhabitants of Terrebonne and La Fourche, who reside very remotely from these large prairies, and secluded from them by intervening forests, are equally, if not more healthy than those living near them."

Apart from the conclusions of Doctor Cartwright, this extract will be regarded as valuable, from the information it communicates on the topography of that region, and the composition of its society, not less than its general salubrity. Of its exemption from autumnal fever, I am disposed to think, however, that Doctor Cartwright speaks in language rather too unqualified; though no stronger, doubtless, than the facts given him by the people during his visit demanded of him. When at New Orleans, in the spring of 1846, I met with Doctor Walter Brashear, an aged and highly intelligent physician, formerly of Kentucky, but long resident on the Lower Atchafalaya, in the midst of the Jussieua, who informed me, that intermittent and remittent fevers prevail annually in that region, but on the whole, are mild — less fatal, indeed, than in Kentucky.

On the hypothesis of Doctor Cartwright, without either adopting or rejecting it, the following remarks may be made:

1. The 'coasts,' as they are called, or banks of the Mississippi, from New Orleans to the outlets of Bayou La Fourche and Bayou Plaquemine, (lying nearly north of the region where the Jussieua is supposed to destroy the cause of autumnal fever), are equally exempt from that disease, and equally abound in aged Creoles, although there are no lakes and no Jussieua; but the river is on one side, and cypress swamps are on the other. I was prevented from visiting the district where the Jussieua grows, but traveled on the coasts.

2. If we examine the locality which the Jussieua overspreads by the facts furnished by Darby, Cartwright, and others, we do not find that it

abounds in those elements to which malaria is generally ascribed. Lakes, *in themselves*, are certainly not of that kind. The bayous, these writers inform us, are natural canals, several feet deep, in which the tides of the Gulf daily librate. The central belts between them, called shaking prairies, are lakes bridged over with matted plants; for fish may be caught by perforating their trembling crusts. The narrow zone of palmetto swamp, which skirts the shaking prairie, is nearly destitute of annual vegetation; and the leaves of that shrub are perennial and most difficult of decomposition. Then comes the narrow tract of cypress swamp, densely overshadowed, and equally devoid of herbaceous vegetation. To this succeeds the belt of cane-brake and deciduous forest trees, so dense that a bird cannot fly through, nor a sunbeam reach the surface, which of course can sustain no succulent annual plants; then a belt of live oak, a quarter of a mile in breadth; and lastly, the narrow zone of long-cultivated, arable land, terminating in the lake or bayou. Compared with the other varieties, the tillable portions do not make a third; and they are no longer subject to the inundations of the Mississippi, which for ages could not have thrown upon them, by its overflowings, any great amount of organic matter; as most of it, in so long a voyage, is either deposited above, or decomposed, or so comminuted, that it remains suspended until the inundation gradually sinks into the Gulf. Thus, *a priori*, we should not expect to see as much autumnal fever in that region, as in those further up the river.

3. Dr. Cartwright ascribes the transparency of the lakes in which the Jusseiua floats, to the action of that plant; but may we not, as plausibly, say, that it prefers clear to turbid waters? With these facts before us, we should, I think, regard the preventive power of the Jussieua as an open question.

CHAPTER V.

THE SOUTHERN BASIN, CONTINUED.

LOCALITIES IN AND AROUND THE DELTA OF THE MISSISSIPPI.

SECTION I.

MILITARY POSTS.

I. Fort Livingston.—On the marine border of the Delta (*Pl. V*), three quarters of a degree directly south of New Orleans, near the mouth of Bayou La Fourche, and at the junction of Barataria Bay with the Gulf, lies the island of *Grand Terre*. Rising about two feet above the highest tides of the Gulf, it has a surface of dark sand, covered with grass, overshadowed with small live oaks. There is sufficient soil for the successful cultivation of melons, and other garden vegetables. From the middle of May to the middle of August, there are land and sea breezes; but the former often fail, and the latter not unfrequently continue all night. For the remainder of the year the winds are variable. In the year 1844, I received the foregoing facts from Captain Barnard, of the United States Corps of Engineers, who had been stationed for four years on the island, engaged in the erection of a Fort. The mean population through that period was fifty, of which four-fifths were negroes. Of the whites, many were directly from the northern states. Captain Barnard was unable to recollect a single case of intermittent fever at that Post during the four years, and but one of remittent fever; the subject of which arrived with the disease upon him. The same was true of yellow fever; not a case of which had occurred, notwithstanding the usual intercourse with New Orleans, through Lake Barataria, had been kept up while the fever was epidemic in that city. Winter diseases he declared to be unknown.

II. Fort Pike.—The *Island of Petites Coquilles*, of which the north side is the site of Fort Pike, lies between Lake Pontchartrain and Lake Borgne, thirty-five miles north-east of New Orleans. Its area is seven by twelve miles; its elevation over the Gulf, two feet. Small shells, with an intermixture of argillaceous deposits, brought down by Pearl River, make up its composition. It is intersected with numerous bayous of salt or brackish water; and all the marshes near or upon it contain water of the same kind. The soil is fertile. In the summer, the prevailing wind is from the south-east, and consequently from off the Gulf. Although so near to New Orleans, Fort Pike has constantly remained exempt from yellow fever; and autumnal fever is far from being prevalent, the ratio of intermittents being nineteen, and of remittents seven per cent.*

III. FORT WOOD.—This Post is distant but seven miles from the last. Its site is on the south side of the pass or channel called Chef Menteur, one of the connecting straits between the two lakes. In its rear there are marshes and cypress swamps, such as cover the isthmus between the lakes and the Mississippi, which are annually replenished with fresh water. Compared with Fort Pike, this Post is decidedly insalubrious. It has been invaded by yellow fever, and the ratio of autumnal fever is high; that of the intermittent form being seventy-six, and of the remittent twenty-seven.

The remarkable difference in autumnal salubrity between these contiguous Posts, is ascribed to the existence of salt marshes near Fort Pike, and fresh-water marshes near Fort Wood.†

IV. FORT ST. PHILIP AND FORT JACKSON.—These Posts are on opposite sides of the Mississippi, about seventy miles below New Orleans. The former, built long since by the French, was abandoned in 1831, for the latter; which stands on the right bank of the river. Situated only thirty miles from the mouth of the Mississippi, these Posts are on the *newest* land of the continent. The cypress swamps here almost reach the river; the banks of which, composed of fine silt and vegetable remains, are so low, that a rise of three feet produces an inundation. They generally remain covered with water from March to June; and when the water subsides, it leaves a new layer of mud and organic matter, which, under the action of a powerful sun, sends up an offensive odor. A strong wind from the Gulf, even when the river is low, may retard its waters, and produce a deluge, followed by a similar stench.

St. Philip was always a sickly station; the same is true of Jackson. Autumnal fever prevails for six months after the fall of the river in June. The ratio of intermittents is one hundred and fourteen, that of remittents fifteen per cent.; and these ratios would have been higher still, if the troops had not, at the coming on of the sickly season for two years, been removed to Posts higher up the river. Malignant cases, however, were not numerous, but relapses incessant.‡ Yellow fever does not seem to have prevailed here.

The *Rice lands* of the Delta, are the narrow banks of the Mississippi, near, but chiefly above, Fort Jackson. They are cultivated mainly by whites, who, as Doctor Randall informed me, are not particularly unhealthy; and Mr. Loer, who resides in their midst, assured me, that he found his locality healthier than the one he had left in Ohio. Low levees, which terminate

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* Med. Stat. U. S. A., p. 270. † Ibid, p. 275.

‡ Ibid, p. 279. Dr. B. Randall, U. S. A., MSS. *pen. me.*

about Fort Jackson, restrain the river above that Post. The peninsula here is so narrow, that the Gulf, especially on the east or left side, is almost constantly in view.

SECTION II.

THE BALIZE, AND MARINE EXTREMITY OF THE DELTA.

I. Topography and Scenery.—We have come, at length, to the most remarkable spot of the continent. In reaching it from the north, as, for example, from the sources of the Mississippi, we travel successively, *first*, on primitive, unstratified, crystalline formations; *second*, on ancient, stratified, semi-crystalline rocks, the whole purely mineral, and as destitute of organic *forms* as of organic *matter; third*, on old secondary rocks, imbedding, in the fossil state, the habitations of marine animals only, and they of species long since extinct; *fourth*, on formations composed in part of the remains of gigantic tropical plants, though lying in the temperate zone; *fifth*, on deposits containing fossil marine forms, bearing some resemblance to those found in the existing seas; *sixth*, on deposits enveloping various animal remains, both of land and sea, most of which have living archetypes; *seventh*, on tracts so recent as to entomb only existing species of animals and plants; which brings us into the locality which has been announced where the work of land making is in actual progress, and we are shown the process of building up a continent from the bottom of the sea. To the medical geologist and topographer, such a locality cannot be destitute of interest; as it affords an opportunity — the only one within the limits of our Great Valley — of contemplating the relations, in a hot climate, between the newest land and the first forms of vegetable and animal life which overspread it; together with its effects, on the health of the first human inhabitants by which it is peopled.

The Mississippi advances into the Gulf by extending its own trough; to which end, the very resistance of the sea is made to contribute; for its waves roll back the sediment which has been carried out, and press it against the growing extremity of the trough, as the weaver's beam drives up the thread; and thus a bar is formed. Through this bar, the river continues to cut its way; leaving, on either side, the refluent silt, as the beginning of new banks, which are, therefore, at first submarine. In this natural masonry, the drift-wood of the river performs an important part. Becoming entangled and fixed, the silt collects around, and is condensed by it; — thus giving us the prototype of our brush-dams across the alluvial streams of the interior. Hence, before the bank has yet been raised above the surface of the Gulf, its place may be discovered by the projecting limbs of trees, which serve instead of buoys to indicate the channel.

Like a skillful architect, the Mississippi lays a broad and deep foundation on which to extend its aqueduct. When the waters escape from the terminal extremities of the different Passes, they spread through a semicircle until the currents are arrested; and thus diffuse their sediment over a broad surface, having less and less to throw down, the further they advance from the axis of diffusion. By sounding on a line drawn from this axis, the water is found to deepen at the rate of a fathom for every mile;* which shows the ratio of inclination of the alluvial plain beneath the level of the sea. The annual floods of the river occasion a long-continued inundation of its banks; during which, deposits are made upon them; and thus the work of extension and that of elevation, proceed simultaneously. From the great altitude of the mountains in which the Missouri River originates, and the loose texture of the broad plain over which it flows, there can be no limits to the advancement of the bed and banks of the Mississippi, until it traverses the Gulf of Mexico and unites its right bank with the peninsula of Central America — forming a salt lake on the west; or pours its waters into the Caribbean Sea between Yucatan and Cuba, or mingles them with the Gulf Stream in the Florida Straits.

But let us return to the present time, and contemplate the existing condition of this advancing extremity of the Delta. For fifty miles before we reach the Gulf, small passes or channels are seen on each side of the river, through which its waters escape, in liberal quantities, during every flood; and thus give *lateral* extension to the great submarine platform. As we descend, these lateral currents multiply, and may be produced at any point, by a little excavation through the low and soft banks. Many of them are navigated by the boats of oystermen and fishermen; who thus make their way by short cuts to the salt water. One, just below Fort Jackson, begun by art, was soon widened and deepened by the river, so as to permit the egress to the Gulf of much larger vessels. After the river has divided into three great Passes, South West, South, and North East, the side bayous still show themselves. The banks are here so low, that it is difficult to find ground on which to build; and as they are often overflowed by waves from the Gulf, not less than by floods in the river, the scattered habitations, all constructed of wood, are elevated on blocks. They are, however, continually sinking; for beneath the partially hardened silt, there is a soft mud, into which, after perforating the crust, a pole may without difficulty be sunk to any depth, unless arrested by buried drift-wood.

As we descend the Mississippi towards its division into great Passes, constituting the apex of what may conveniently be called the Balize Delta, tree after tree disappears. Immediately below Fort Jackson, the species become few, and the individuals are sparse and of reduced size. The cypress and liquidambar fail; but an ash, the sycamore, the one-seeded honey locust,

* Med. Stat., U. S. A., p. 270.

the thick-leaved hackberry, and the cotton tree, still show themselves, with now and then a live oak. Luxuriant tufts of mistletoe are occasionally seen, and festoons of long moss are not wanting, though less profuse than higher up the river. The grove is at last reduced to palmettos, arborescent elders, and gigantic black willows; the last of which venture further into the waters than all the rest, and finally come to be nearly the sole representatives of the forest. But in passing beyond the limit of the woods, we do not leave the vegetable kingdom, for the eye rests on boundless fields of reed-grass (*Phragmites communis*), the culms of which rise to the hight of fifteen or twenty feet, and in appearance replace the cane-brakes, which luxuriate on the higher banks of the river, but cannot flourish with their roots steeped in brackish water. From the upper deck of his steamer the traveler here sees the grand system of natural canals, into which the Mississippi finally divides; and contrasts the color of their turbid waters, with the greenish tint of those with which they are about to mingle. Each canal has its winding vista, and when buried too deep in the distant jungle to be seen, its banks are indicated by ranges of willow trees. Between the principal Passes, there are shallow ponds of brackish water, with mud bottoms; but salt marshes, too soft in most places to be passed over by men or cattle, constitute the greater part of the surface. In the more fluid parts of these marshes, we find the reed-grass less abundant; but the *Typha latifolia*, *Scirpus lacustris*, and other aquatic plants, become more numerous.

Of animals, herons and other wading birds, wild geese, gulls, eagles, and the purple grakle, are common; the banks of the bayous are perforated by millions of the fiddler crab, with one large and one small claw; now and then a porpoise ascends the stream by successive vaultings, which carry his back above the surface; an otter sports or dives along the banks; and alligators, in multitudes, lurk in the jungle which overhangs them.

II. Geology. As in the *general* Delta, so in the *subordinate* or Balize Delta, there are three great geological elements — silt, drift-wood, and the remains of plants and animals which grow upon it. The amount of drift-wood is much less than is generally supposed. Arrested by the tides, it lodges in the recesses of the bayous, where it becomes fixed by silt, and willows soon take root upon it; while that which lies in the brackish water is bored in all directions by the *teredo navalis*. Gradually penetrated with silt, it becomes semi-fossilized, and ultimately constitutes an integral part of the formation. As most of the plants growing on the spot are gramineous, with culms containing silex, their decomposition is slow, and undecomposed beds no doubt exist beneath the surface at every depth. To these remains must be added those of the *testacea*, which inhabit all the inlets and little bays, which are filled with the waters of the Gulf. Finally, these waters penetrate the Balize Delta, and impregnate the whole formation with common salt; which effloresces whenever the surface dries. Thus immersed in weak brine, the organic matter, either resting on the surface or buried beneath, may have its decomposition protracted and essentially modified.

The bars are ridges formed as already intimated, by the conflict of the moving waters of the Gulf and river. They advance gradually into the former; which contends, but still recedes. The ratio of this advancement has not been accurately ascertained. Mr. McCullough tells us,* that while he resided, for five years, near the bar of the South West Pass, it advanced into the Gulf a quarter of a mile. Mr. Vanderslice, an observing and reliable pilot at the Balize, informed me that the bar of the North East Pass had advanced nearly half a mile in eleven years. These data would give five miles in one hundred years. Other data have both augmented and diminished this ratio. No doubt, different bars (and even the same at different periods) are pushed forward at varying ratios, according to the quantity of water directed against and over them. Thus, at the present time, very little flows in the South Pass, compared with the South West, and its advance, we may presume, is correspondingly less. A channel, made by dredging transversely through the middle of the bar in the North East Pass, was soon filled up by the subsidence into it of the soft, unsupported walls of the ridge left after the dredging.

Portions of the bars present, at times, a sort of intumescence, or bulging up, which, after a while, disappears. The first notice of this movement, which I recollect to have seen, was by Mr. William McCullough, in 1837. When at the Balize, six years afterwards, I made this phenomenon the subject of inquiry, and from the late Captain Taylor, boarding officer of the port, Mr. Vanderslice and other respectable pilots, I obtained the following facts.

1. A sloop was lost on a breaker near the entrance of the North East Pass. The water was merely deep enough to cover her. After having been almost a year out of sight, she began to reäppear, and in the course of an equal length of time, even her lowest timbers were three or four feet out of water. The area on which she rested was estimated at an acre and a half. While on her way up, the waves tore off her planks, washed out the silt, and exposed her ballast, much of which was taken out. In the course of another year, both the bank and schooner had disappeared.

2. A vessel grounded near or in the same Pass, and to lighten her, the ballast, consisting of bricks, was thrown overboard, in water eight or nine feet deep. In less than a twelve month, the bricks appeared above the surface, resting on a mud bank. Many of them were brought into the Balize. Not long afterwards, those left behind, with the bank on which they rested, sunk gradually below the surface, but not to their former depth; for the water has since been shoaler over that spot than before.

3. At the same Pass, a ship from Liverpool, having as ballast, curbstones, for use in New Orleans, required to be lightened; which was done by

* Documents, p. 77.

throwing them overboard, in water fifteen or sixteen feet deep. In a little more than a year, they began to show themselves above the water, and the bank on which they rested, continued rising, until its surface, to the extent of half an acre, was five or six feet out of water. In a few months it began to subside, and at length disappeared. But the water is not so deep at that spot as before.

4. A vessel called the Condor, after losing her anchor in water nearly eighteen feet deep, was herself sunk in still deeper water. In the ensuing year the anchor was raised until it was only three feet beneath the surface, but nothing was seen of the ship.

These various masses of mud, became so hard under exposure to the sun, that men could walk upon them. They disappeared either by sinking or by the action of the waves; but we come now to examine others which have remained permanently above the surface of the Gulf.

In various places along the marginal line of this long, alluvial cape, are islets, the present elevation of which above the Gulf could not have been the result of deposits from the river. Mr. McCullough mentions one near the South West Pass, which was twelve feet above the surface of the Gulf and had received the name of Gibraltar. Another, at the same Pass, on which he resided, was eight feet high; but subsequently had sunk to four.

At the mouth of the Pass a la Loutre, I visited one, the highest points of which were only three or four feet above the water, which was shoal all around it to the extent of many acres. Its surface was firm, but not dry; for the spray of the Gulf, and, to some extent, the waves, dashed over it, and had manifestly reduced its altitude. Great numbers of water-fowl made it a place of resort. By the action of the rains and waves, the surface was cut into miniature river channels, inlets, and bays, sometimes filled with water, and at others empty. The surface was a stiff, blue clay, fragments of which, rolled by the currents, had become smooth and molded into spheroidal, oval, or reniform masses, resembling the rolled pebbles of the interior of the continent. The whole structure of the island, as seen where channels had been cut in it, was stratified or lamellar, with a dip or inclination to the north. It did not contain either fragments of rock or fossil wood.

In front of the Balize Bayou, a branch of the North-East Pass, lie two islands of deeper interest than the last, though evidently of the same class. They are separated from each other by a narrow strait or creek. Their lower portions are overflowed by high tides; but their more elevated points are seven or eight feet above the mean surface of the Gulf.

The eastern, and, at present, smaller of these islands, sustains the action of the waves, which are evidently truncating it at the water level, thus creating a wide, soft beach, and a glacis or bluff bank, several feet high. In this bank, and also in the ravines of the beach, a distinct stratification is everywhere presented, with a dip, as well as I could determine, to the east, and a line of bearing from south to north. On its beach, the tide being off, I found a feeble spring, the water of which was as strong as brine, while that of the adjoining Gulf, diluted by the river, was only brackish. *Along* with the water there was an escape of gas, and *from* it a deposit of sand and oxide of iron. The temperature of this spring, eighteen inches below the orifice, was, on the 4th of March, 1843, sixty-four degrees, Fahrenheit; that of the beach, at the same depth, fifty-six degrees; which, from the season of the year, may be taken as the winter heat of the ground at the edge of the Gulf, where the marine and river influences are blended. No fossil wood or pebbles were to be seen on this beach, or in the adjacent bank.

The other, larger and more elevated island, is, as I have said, separated from the one just described by a narrow bayou. Its structure is the same with that. Scattered over its surface, there are several salt springs, all apparently of one character. Each has a sort of crater, lined with a glazing of oxide of iron, deposited by the water as it flows out. In some of these craters the water was at rest, while it was flowing out of others. From the latter, there was an extrication of gas, but none from the former. In some obsolete fountains, there was an escape of gas without any water being visible. Around the whole, there were broad deposits of sand, which were deepest at the craters, and declined in all directions.* This inundation of sand, analogous to a deluge of lava, by mingling with the argillaceous surface of the island, has given it a high degree of fertility. I sunk a pole sixteen feet into the largest of these craters, without meeting with any obstruction. The temperature at that depth was sixty-five degrees. By raising over this orifice a mud cone, the sides of which were thicker than the summit, water and gas were made to burst from the latter; but when the gas was conducted through the sides below, the water ceased to flow from above, although it was prevented from escaping through the lower orifice. This experiment, together with the stagnation of the water in every crater from which there was at the time no escape of gas, shows conclusively, that it is to the evolution and escape of gas we should ascribe the fountains, and to *them* the ejection of sand. The water of the spring on which the experiments were made, was noted at the time as being intensely salt;—it was, in fact, undiluted sea water. It tarnished silver when laid in the issuing current, and the gas burned with a sulphurous smell, and hence must be regarded as sulphuretted hydrogen,—the same gas that is evolved with the water of many of the 'salines,' or brine springs of the interior of the continent.

It appears from all that has been said, that there is beneath the ultimate or Balize Delta, a focus of gaseous evolution, and that the upward pressure of the gas, is most probably the cause of the strange insular upheavings of that quarter, some of which subside, while others, sustained below,

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* Mr. McCullough has described the same at the South West Pass.—Documents, p. 78.

remain until washed away by the waves. On the chemical actions by which the gas is developed, I shall offer no speculation. Of the depth at which they take place, nothing, I suppose, can with certainty be determined. It may be either within or beneath the alluvial deposits. The limited area of the tuberosities, would seem to indicate the former; and still, if the gas were generated below the bed of silt, it might, perhaps, permeate it in such a manner as, at last, to produce but limited upheavings. I did not learn that earthquakes had at any time been generated by it. To the medical etiologist, the important fact is the constant escape, over the area of the lower Delta, of so great a quantity of sulphuretted hydrogen. I say great, because there is no reason to believe that the discharge is limited to the elevated spots: it probably goes on throughout the whole savanna, and the adjoining parts of the Gulf.*

In conclusion, I must recur to the surface and productions of the last described island. The origin and character of its soil have been already indicated. The greatest difference between it and the surrounding alluvion, consists in the presence of sand in one, and its absence from the other. Both are supplied with salt and fresh water; — that of the island receiving the former from springs, the latter from the clouds; while the alluvion is, alternately, or conjointly, inundated by the river and the Gulf; hence, both are muriatic, while one is dry and the other swampy. The vegetation harmonizes with these conditions. The aquatic and sub-aquatic grasses of the swamps are absent from the island, which offers in their stead the *Myrica carolinensis*, or candleberry myrtle; the *Rubus trivialis*, or dew berry; the *Solidago sempervirens*, or golden rod; the *Salicornia herbacea*, or glass wort; and the *Salsola soda*, or salt wort — the two latter having a saline taste. Garden vegetables are also cultivated on the island by the fishermen; and peach, cherry, quince, and fig trees, planted in former times by the Spaniards, are now growing wild.

Such is an outline of the geology, topography, and hydrology of the Balize Delta. If I have introduced some things not strictly relevant to medical etiology, it was because of its singular and remarkable character; constituting it one of the most interesting of all the localities of the Great Interior Valley. In accordance with this impression, I propose to depart still further from the method pursued in describing other places, and give some account of the people and diseases of this locality.

III. INHABITANTS.—At the end of the Pass a la Loutre, there are no inhabitants: at that of the South Pass, there is a lighthouse to warn navigators of a neighboring reef: at the termination of the South West Pass, through which all the larger vessels enter and depart, there is a lighthouse, and houses for a boarding officer, with eight or ten pilots, some of whom

* Although I have spoken of this as sulphuretted hydrogen, on the strength of the experiments mentioned, it may perhaps be carburetted hydrogen.

have families: at the bar of the North East Pass there is a lighthouse: all the other habitations (an occasional fisherman's hut excepted), are at, or rather, constitute—

THE BALIZE.*—Two or three miles above the bar of the North East Pass, a deep and tranquil bayou, resembling a broad canal, turns directly to the south, and reaches the Gulf at the distance of two miles, on either side of the two islands which have been described. On the right bank of this bayou, just below its efflux, stands the village of Balize, in N. Lat. 29° 7′ 15″, and W. Lon. 89° 4′ 36″. It consists of small buildings erected on blocks, with a single narrow and serpentine street or promenade, which follows the curves of the bayou, and has an elevation of but a foot or two above its waters. At the distance of one hundred or one hundred and fifty feet from the bank on which this street meanders, is the edge of an impenetrable reed-grass swamp. Low as the bank still is, it has been raised, as have many of the little garden spots in front of the buildings, with soil from the opposite side of the bayou. The new ground beneath is, however, so soft, that the increased weight tends to sink the street; rendering new additions necessary, from time to time, to keep the street and yards dry. Occasionally, under high south-east winds, the site of the whole village is inundated. When a spot is first reclaimed and planted, it produces badly; but as the ground is stirred and the rains wash out the salt, it undergoes amelioration, and yields the ordinary garden vegetables of the south in good perfection; while the peach, and many southern flowering shrubs flourish equally well.

Its People.—The population of the Balize is about two hundred and fifty; consisting almost entirely of pilots, about forty in number, with their families, a few artisans required by their vocation, a teacher, a physician, and a number of slaves. Many of them have resided on the spot for twenty or twenty-five years. A few families occupy the opposite bank of the bayou. Until within the last ten or twelve years, there were but few females; now, nearly all the pilots have wives. Thus there is a population sufficiently numerous and diversified to test the salubrity of this remarkable spot;—the legitimate object of this extended article.

My inquiries on this head were not limited to Doctor Henry Van Antwerp, the salaried physician of the Pilot's Association, who had resided there for three years and a half; nor to the late Captain Taylor, the boarding officer, who had lived at the place sixteen years; but extended to many of the pilots and their wives, on whose intelligence and respectability I could rely. In giving the results obtained, I propose, in view of the unique condition and character of this locality, not to limit myself to the diseases mentioned

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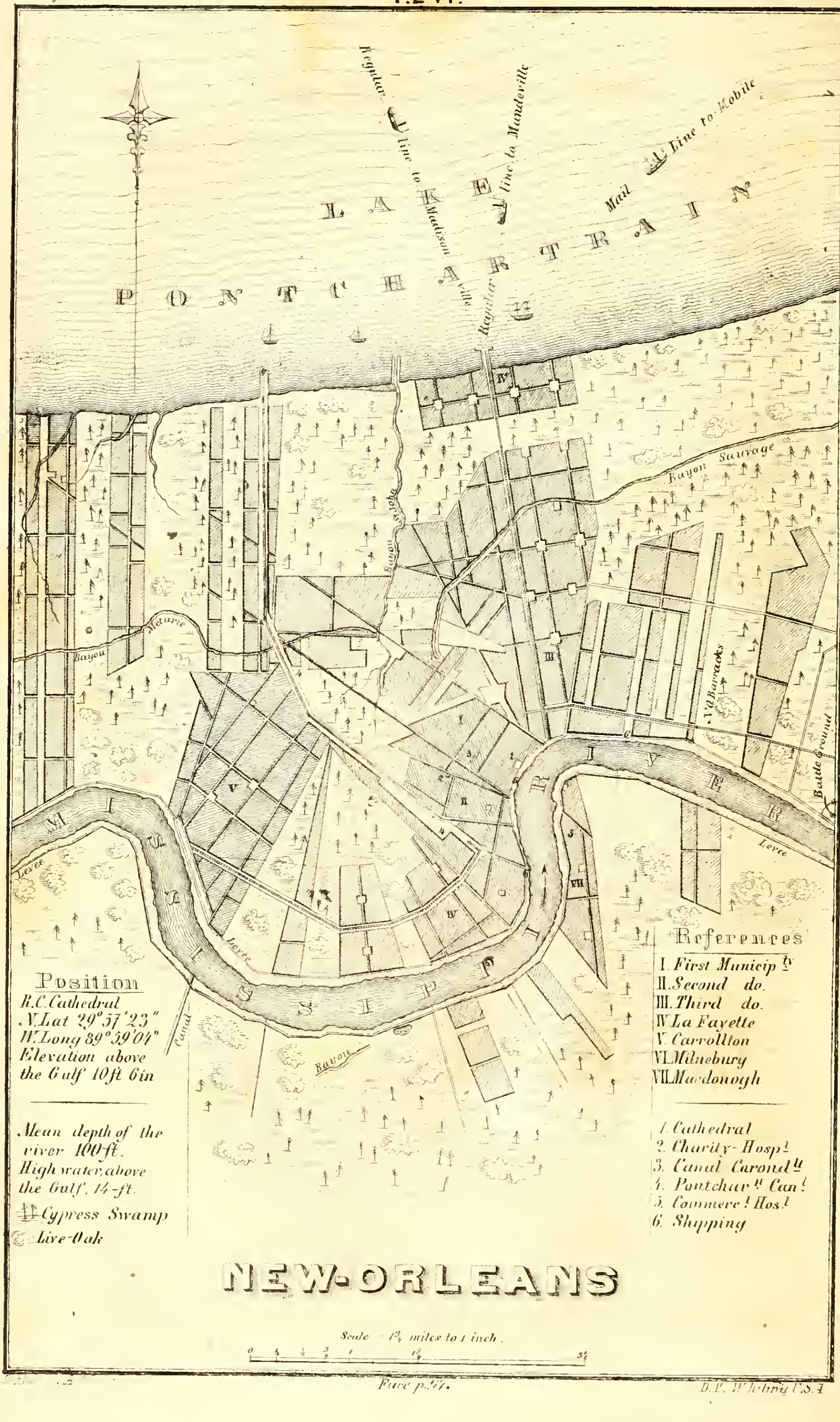
* Corrupted from *Valiza*, Spanish, a beacon. On this spot the first signal for indicating the entrance into the Mississippi River was erected. The present lighthouse is two miles further down the North-east Pass.

under other topographical heads; but to relate the substance of all I could collect.

Their Modes of Living.—Before commencing, it will be proper, however, to say a few words on the pursuits and modes of living of the people. The duties of the pilots call for great exposure, as a number of them are at all times cruising off the bar, in open boats. Formerly they were extremely intemperate, but in latter years, their habits have improved; still, the improvement is more in reference to the abuse than the use of ardent spirits. In summer a liberal quantity of claret is consumed. Tea and coffee are in general use, and the latter is frequently drunk on rising in the morning. Culinary vegetables are not abundant, and animal food is the staple of the diet of the whole population, being eaten three times a day. It consists chiefly of salted meats, fresh pork, beef, poultry, fish, and oysters.

Their Diseases.—The prevailing disease at the Balize, and the South West Pass, is intermittent fever, generally of the tertian type, and mild in its character, with a tendency in the patients to relapse. Doctor Van Antwerp had seen only two malignant cases. Some immigrants have lived there several years before they sickened. Mrs. Anderson, who had resided there longer than any other individual, thought the disease much less frequent than formerly. Doctor Van Antwerp had noticed a considerable number of diseased spleens, but very little neuralgia or dropsy, consequent on the fever. Remittents appear to be decidedly rare, and the same is true of yellow fever, notwithstanding almost every vessel from Havana and Vera Cruz enters through this Pass, and is visited by the pilot and boarding officer. Doctor Van Antwerp arrived in October, 1839, when the fever was extensively prevalent around the shores of the Gulf, including, of course, New Orleans; and in 1841 and 1842, it was prevalent in that city and some other places; still he had seen only four cases; one of which occurred in a person from New Orleans; two others seemed to have originated in the village, and the fourth occurred in an oysterman, who declared he had not been at New Orleans. These cases occurred in different years. Eruptive fevers are exceedingly uncommon, and chronic cutaneous disorders seldom show themselves. The itch is said to lose its contagiousness, and at length cease. The summer gastro-intestinal affections, such as cholera morbus, cholera infantum, and dysentery, especially the two former, are unfrequent. Pulmonary inflammations of all kinds are quite as uncommon. Doctor Van Antwerp was induced to remove from the state of New York to the Balize, on account of his liability to pulmonary catarrh, which his residence at the latter place has nearly removed. Croup is almost unknown. Of nervous diseases, convulsions of children are more frequent than all the rest. Doctor Van Antwerp had seen nine cases, five of which proved fatal. The number of children among whom they occurred, was about forty — the time, three and a half years. The children who suffered, were not, as it is termed in the nursery, "within the month." Another disease of frequent occurrence is rheuma-



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tism, which is generally subacute or chronic, and falls especially on the pilots who are greatly exposed. Consumption is said to be rare. Captain Taylor, who had resided there sixteen years, could recollect but three cases, and the patients had all arrived there with the disease in its forming stage. Nevertheless, his wife, who many years before had left the state of New York, was evidently falling into that disease, and two of his children, born at the Balize, had strumous swellings and abscesses of the neck.

The negroes of the Balize are fed on nearly the same food with the whites, but lodged in damper situations near the ground; nevertheless, they enjoy still better health than their masters. Almost their only disease is mild intermittent fever, to which, moreover, they are less liable than the whites. They average fifty in number, and during three and a half years there had been but two deaths.

It results from this rapid sketch, that no new disease has been developed in this locality; that several appear to be less prevalent here than in the interior; and that autumnal fever is not as malignant as we find it in many extensive districts of country several degrees further north.

SECTION III.

NEW ORLEANS.

I. Position and Plan.—The City of New Orleans (*Pl. VI*) stands on the left bank of the Mississippi River, in N. Lat. 29° 57′ 23″, and W. Lon. 89° 59′ 4″.* After having, from its sources, pursued nearly a south course, the river, as we have seen, while traversing the Delta, turns to the east, and then to the south-east, until it reaches the Gulf. It is thus brought near, and parallel to, the southern coast of Lake Pontchartrain, so as to form a kind of Isthmus, formerly called the Island of Orleans; which at the narrowest point is not more than five miles in width. When opposite the middle of that lake it makes a horse-shoe bend by the south, and then flows off in its general course. Around the lower part of this bend, on the left bank, we have the site of the City.

By examining its plat (*Pl. VI*) it will be seen that the center consists of the old or original town, having the form of a parallelogram; one end of which rests upon the river, while its sides, and the streets parallel to them, stretch from the bank in a northern direction. This portion is now called the *First Municipality*. Immediately below, the river having a south-easterly direction, lies that extension of the old town, which now constitutes the *Third Municipality*, the streets in which run from the river, to the north, and north north-east. Above the original town, and consequently within the horse-

* It will be convenient, and cannot lead to any practical error in a work of this kind to speak of this city as having the latitude of thirty, and longitude of ninety degrees.

shoe bend, is the *Second Municipality*, with streets running north-west, from the river. Adjoining this Municipality, on the south-west, and near the bottom of the horse-shoe bend, is the faubourg or city of *La Fayette;* above which, on the river bank, are two or three *projected* villages; after which, as we rise out of the concavity, to the north-west, we come to the town of *Carrolton;* the streets of which run north north-east. Thus the line of coast, from the western limit of Carrolton to the eastern boundary of the Third Municipality, is at least twelve miles; and public or private enterprise, in anticipation of the future, has already sought to give the great commercial metropolis of the *Mexican* or *Southern Basin*, that extension. This, however, will appear the less remarkable, when we recollect, that the spread of the city back from the river cannot be effected without great labor and expense. At present, a line of three miles, the center of which shall be the adjacent angles of the First and Second Municipalities, will cover those portions of the city which are of most interest to the physician.

The right bank of the river, is not without its attempted towns. Opposite La Fayette, are Cosmopolite and Gretna; across the river from the First and Second Municipalities, lies MacDonoughville; and facing the Third Municipality, stands Algiers; all of which are but inconsiderable places.

From the dome of the St. Charles Hotel, standing near the center of the city, the periscope presents many germinal villages, which suggest to the mind a true idea of the vast relations of this spot with the interior; the inhabitants of which, in augmenting numbers, must forever continue to visit New Orleans, and thus maintain the interest of the medical profession, in all that relates to its diseases.

II. Lakes and Swamps.—Directly north of the city, at the rectilinear distance of seven miles from the bottom of the horse-shoe bend, and about four and a half from each of its extremities, lies the southern coast of Lake Pontchartrain. To the east, at the distance of twenty miles, is the coast of Lake Borgne. At the same distance, to the south-east, is the small Lake Lery; at double the distance, Chandeleur Bay. On the opposite side of the river, to the south-west and south, are Des Allemands, Ouacha, Petite, Hermitage, and Ronde Lakes, with Barataria and Bastion Bays, varying in distance by straight lines from ten to thirty or forty miles from the city.

Thus New Orleans is nearly surrounded by lakes and bays; to the west only are they absent; and there the river in some degree supplies their place, by meandering from west to east for seventy or eighty miles. Even this, however, presents an inadequate idea of the extent of watery surface; for in every direction from the city, unless when we travel on the 'coast,' or river bank, we encounter cypress swamps, terminating, either at the shores of a lake, or in grassy savannas too wet to be traveled over. Before levees were raised upon the banks, the whole region was annually overflowed; but during nine months of the year, a strip on each side, varying from a few yards to a mile in width, was dry on the surface, yet abounded in water underneath. At New Orleans, as everywhere along the lower Mississippi, this strip was highest next the river, and not only the overflowings of the stream when swollen, but the rains, took a direction from the river, and replenished the swamps and smaller lakes. The elevation of the bank on which the city stands was but a few feet above the surface of Lake Pontchartrain, and Lake Borgne.

III. BAYOUS.—These lakes are, and must forever remain, the reservoirs into which the swamps around New Orleans discharge their superfluous waters. The draining is effected by natural canals or bayous, which I proceed to enumerate.

1. To the north-west of the city, there are two or three, which run from the swamp into Lake Pontchartrain; one of which is called *Bayou Chapitoulas*. They do not exert much, if any, influence on the city.

2. *Bayou Metairie.*— Further west, and nearly equidistant between the sources of these bayous and the river bank, is the beginning of the Bayou Metairie. Its course is eastward, until it joins the larger bayou, to be mentioned next. The Metairie is cut by the new ship canal from Pontchartrain to Julia street, in the Second Municipality, and now, of course, discharges its waters into that trough. Along this bayou, there is considerable redeemed land, and a good road.

3. *The Bayou St. John.*— Of all the bayous between the left bank of the river and the lakes, this confers on the city the most important benefits. Originating, by several branches, in the Second Municipality, about two miles from the river, it traverses the First Municipality, and thence makes its way directly north, to Pontchartrain. Its waters, of course, flow with a feeble current, but are deep enough for sloop navigation.

4. *Bayou Sauvage or Gentilly.*—Its origin is near the dividing line between the First and Third Municipalities, about two miles from the river. At first, its course is nearly north, but it bends to the north-east, and finally discharges its waters into the Pass called Chef Menteur, one of the connecting straits between Pontchartrain and Borgne. Along this bayou, there is also a road, and borders of arable land.

5. *Bayou Bienvenu*, which originates in the eastern part of the Third Municipality and flows to the east.

6. *Bayou Mazunt.*— It rises a little further down the river, and flows nearly in the same direction.

7. *Bayou Mercier*, which begins still further down, and runs to the north-east.

The last three bayous unite, and under the common name of Mazunt, flow into Lake Borgne.

Thus we see that the declivity between the left bank of the river and the lakes, has numerous swamp-bayous or natural canals, which constitute the basis of a hydraulic system, by which a large portion, if not the whole tract, might, by human labor properly directed, be drained and dried.

IV. Dikes.—But, without ditching, nothing of substantial value can be accomplished; for, although the fall from the river to the lakes is about twelve feet, much of it is near the former, and the declivity gets less and less as we recede from the river. Hence the water, after it has sunk to a certain level, will not flow off from the swamp, without receiving an impulse from the hand of art. When intersecting or confluent ditches are dug, and a common trunk is made to open into one of the bayous, the water gradually drains into it; not only off, but from beneath, the surface, down to the level of that which is in the ditches. In this manner the waters of the swamps are collected into the dikes which are dug through them; but the inclination is too little to impart much current, and hence, to the full effect of emptying the marshes, it has been found necessary to establish a current from their ditches into the bayous. This is done by the paddle-wheels already described in speaking of the Delta generally. The only bayou, however, into which the waters have yet been driven, is St. Johns.

V. Canals.—In 1776, Baron de Carondelet, Spanish Governor of Louisiana, finished the sloop canal, which still bears his name. Its length is a mile and a half. One end terminates in the Bayou St. John; the other, within half a mile of the river, where there is a basin; which was dug in what had, up to the time of its excavation, in 1796, been a public cemetery. The whole is within the old city, now called the First Municipality. According to Dr. Thomas,* the yellow fever which occurred in the autumn of that year, was the first which had visited the city; but I have learned from one of the oldest and most respectable Anglo-American citizens, Richard Relph, Esq., that it occurred, he himself being a patient, in 1791. The effect of this canal was to promote the drying of that part of the swamp through which it passed.

The *New Orleans Canal* was excavated many years afterwards. It extends from a basin at the end of Julia Street, in the Second Municipality, to Lake Pontchartrain, a distance, following its banks, of nearly six miles. The excavation of this canal through a cypress swamp, was at the expense, as I have been assured by Dr. Meux and Dr. Barton, of several hundred lives. The work was continued through summer and autumn, and the laborers were chiefly immigrant Irishmen. They did not, however, perish of yellow fever, but of intermittents and remittents. As the water in this canal, is on a level with that of Lake Pontchartrain, ditches for draining the back part of the Municipality, and, indeed, the whole swamp between it and the lake, may be conducted into it.

VI. Street Currents.—The rains that fall on the city plat, which inclines from the river, must, of course, take the direction of the swamps. As far as the gutters are paved, the water flows with sufficient velocity to carry

* Essai sur la Fièvre Jaune D'Amérique. 1823, p. 70.

forward much of the filth thrown in them; but where they are unpaved, most of it is left behind, the superincumbent water slowly draining off, and leaving semi-fluid deposits of mud. Many of the cross streets, moreover, have so little fall, that their gutters, except immediately after copious rains, present a very foul aspect. For several months in the year, however,— that is, from winter to midsummer,— the gutters of every street running from the river, might be washed out by a lively stream; for, throughout that period, the river is high enough to discharge its waters into them through depressions or tunnels in the levee. In the old city, now First Municipality, many of the gutters are subjected to this purification; and the whole should be brought under the same influence. With such a hydraulic system, the city might have its filth successfully transported to the swamp, or even to the bayous and canals which open into the lake, which would be much better.

VII. Inundations.— To whatever extent a system of ditching may be carried, the isthmus between the city and the lakes will forever remain liable to occasional inundations.

1st. Heavy rains, when they happen to coincide with a defective or suspended action of the machinery which propels the water from the main dike into the bayou, will occasion partial inundations; an instance of which I witnessed in the spring of 1846, when riding through the northern part of the First Municipality, with Dr. Meux.

2d. A crevice in the levee above the city, at any point below Bayou Manchac, may produce a much more extended inundation; such as occurred in the year 1816. As the water, which was three or four feet deep, drained off rapidly into the lakes, it was supposed to carry with it a great deal of filth, and seemed to have had a salutary effect on the health of the city.*

3d. Under strong winds from the north and north-east, the waters of Lake Pontchartrain may be thrown into the swamp to the depth of several feet, and even come into the thickly settled parts of the city; an event which has happened more than once. Against this kind of deluge, there can be no protection; and it should not, perhaps, in reference to the health of the city, be regretted; as it occurs upon a surface, which, under any degree of ditching, is likely to remain inordinately moist; and the recession of the water can scarcely fail to carry off a large amount of filth.

VIII. Forests.—To practice ditching, it is necessary to destroy the forests which overshadow the swamp; but this should not be done until the ditching can be commenced; as an exposure of the surface to the rays of the sun, must, of necessity, quicken the decomposition of organic matter.

IX. Fevers of the Swamp.— The inhabitants of the suburbs of the city, who live adjacent to, or within, the swamp, but seldom affected by

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* Rapport Publié au nom de la Société Médicale de la Nouvelle Orleans, Sur la Fièvre Jaune, 1819, p. 50.

yellow fever, are liable to intermittent and remittent fever; but cases of great malignity are not particularly common. These fevers sometimes reach the center of the city, but such invasions are not annual.

We must now transfer ourselves from the swamp, to the river side of the city.

X. THE BATTURE.—For a great length of time, the Mississippi, during its annual floods, has been depositing silt in front of the city; thus raising and widening its bank in the direction of the opposite side. This new alluvial formation has received the name of Batture. The efficient cause of its deposition, is an eddy, or counter current, which exists from some point in the Third, to a point in the Second Municipality, and the momentum of which is sufficient to turn the sterns of steamboats which lie at the wharves *up* stream — that is, in the opposite direction from that in which the general current of the river would place them. As long as the cause of this eddy continues, the growth of the Batture will, of course, go on, and be accompanied, as it is, with some encroachment of the river on the opposite bank. Large portions of the new alluvial plain have been built upon, but a wide margin remains uncovered with houses, and presents the appearance of a common, which even the mighty commerce of the interior, can but partially overspread with the products of the soil. Portions of the outer edge have been raised, by art, above high water mark; while others are covered with planks supported by props, constituting docks, which are extended so far out that steamboats can lie at their terminations.

XI. CITY FILTH ALONG THE RIVER.—The streets adjacent to the river for three miles, are compactly built up, and from the dwelling houses, taverns, drinking houses, warehouses, market-houses, oyster-sheds, sugar-wharves, and cotton-presses, a vast quantity of filth, and organic recrements, find their way into the water's edge; and although a portion may be wafted off, much is deposited on the subaqueous batture, and, with the fall of the river, subjected to solar influence. * In three visits to New Orleans, I ascertained, by personal inspection, that the condition of things described by Dr. Picornell, in 1823, still continued without much abatement, twenty years afterwards. Within that time, the police had, it is true, been greatly improved; but the population had also greatly increased, with an inevitable augmentation of foul and corrupting offals.

XII. BOATS AND SHIPPING.—The last head gives a very inadequate idea of the amount of filth thrown into the river opposite the city. Its commerce during six months of the year, is too great to be estimated by those who have not seen it. Three classes of vessels carry it on — flat boats, or arks, steamboats, and ships.

* Des Considérations Hygieniques sur la Nouvelle Orleans. By J. M. Picornell, p. 19, 1823.—Essay on the subject of Quarantine Laws. By W. P. Hort, M. D., New Orleans Medical Journal, Vol. II, p. 1.

The first lie chiefly opposite La Fayette, and further up the river to Carrolton. Their number is immense, and various kinds of filth, with damaged cargoes, are thrown from them, into the very margin of the river, whence they are but partially floated off. When the boats are sold, and those who descended the river have left them, they often lie, for a long time, attached to the bank, or half sunken, and contain accumulations of foul and putrifying matters exposed to the rays of the summer's sun.

The steam boats lie chiefly in front of the center of the city, divided between the adjacent portions of the First and Second Municipalities. Their freight is cotton, sugar, and produce and provisions of all sorts. The number of persons on board of each, while lying at the wharf, cannot be less than fifty; and the laborers occupied near the water's edge, might be counted by thousands. Thus the amount of filth and feculence which falls upon this part of the batture, during spring and the early part of summer, is very great.

The ships, not anchored in the stream, but attached to the docks, are found in two different places, in front of the Second and Third Municipalities — the steamers intervening. Nearly every ship, in reaching the port of New Orleans, has sailed within or very near the tropics, and arrives, of course, with its hold in a filthy state. The work of debarkation and purification is conducted where they lie; and consequently, they contribute a full proportion to the foul accumulations over which they ride. *

From the various sources which have been indicated, after making ample allowance for what is floated off by the current, there must be annually deposited with the river silt, upon the sloping margin of the Batture, for three miles in front of the city, a deep and foul stratum of organic recrements; which, on the subsidence of the river, from July to November, is exposed to the burning sun of the thirtieth degree of latitude. If there be any gases, noxious or innoxious, developed during that period, a portion of them may be absorbed by the river, but the greater part must be wafted into the city; for the prevailing winds are between south-east and south-west.

XIII. Fevers of the River Side.—For the purpose of comparing this side of the city with that adjacent to the swamps, I will remark, that this is the locality of yellow fever, as the other is of autumnal intermittent, and remittent. The latter, however, occur here also; but many of the cases are in persons from the interior, who arrive with the semina of the fevers in their systems and become patients, either in the boats which bring them down, or in the watermen's boarding houses.

XIV. Condition of the City.—The streets in general are of moderate width; a few are broad, but a greater number narrow, using those terms as one familiar with the towns of the interior is likely to employ them. For a long period of time but few of them were paved; latterly, however, that important improvement has been advancing with commendable rapidity. The stones

* Dr. Hort.

are brought from the Eastern States and Europe, as ballast, by ships engaged in the cotton trade.

The squares are generally small, and consequently their central parts are much covered over with back buildings. The houses are very unequal and unlike each other; the old French and Spanish domicils being mostly of wood, one or two stories high, and faced or surrounded with verandahs. In the old or First Municipality, there are, however, many three story brick, as in the American or Second Municipality there are many frame houses, built after the fashions which prevail in the interior. Arrangements for warming and drying are, in many houses, defective and inadequate: and the invalid from the upper country, who may have been accustomed to lodge in dry and warm rooms, will probably find himself placed, in winter and early spring, in a chamber which, to his feelings, will prove both cool and damp. The diet of the inhabitants approaches too near to that of the people of the United States generally, to justify the opinion, that any peculiarity of constitution or diseases which may exist, depends upon it. Vegetables of various kinds are abundant; and if butcher's meat is less used, the animal element is made up by fish, eggs, bacon, and oysters. Coffee is in universal use, and taken by multitudes before breakfast. Claret is drunk copiously, and generally throughout most of the year; but ardent spirits are likewise used with great liberality. Formerly, well-water, the composition of which has been already given, was extensively used; but since the year 1836, there has been a liberal supply of river-water, pumped up from a point above the ship and steamboat wharves, into a reservoir with partitions, so that the deposit of sediment is going on in some, while the water is flowing off from other compartments.

XV. Composition of Society.—The settlement of New Orleans was begun by the French in the year 1718. From the beginning, African slaves made a part of the population. Settlements were soon made both above and below the town. Five years after its foundations were laid, a company of Germans, who had left Europe for the purpose of settling on the Arkansas, were disappointed in their object, and established themselves on what was therefore called the German coast, from thirty to forty miles above the town, whence many of their descendants became mingled with its population. Meanwhile, immigrants from France continued to arrive, and while a portion remained in New Orleans, others settled on the coast above and below the town; and on the banks of the Bayous La Fourche and Tèche. In 1754, a body of French from Nova Scotia, then called Acadia, having left that province in consequence of its conquest by England, migrated to Louisiana, and settled partly in New Orleans, but chiefly on that part of the river bank above the German settlement, which has since been called the Acadian coast. In 1763, Louisiana was ceded by France to Spain, but the latter did not obtain possession until 1769, fifty-one years after the settlement of New Orleans. An immigration of Spaniards now took place, but not, I think, to such an amount as materially to affect the composition of society. The Spanish domination continued thirty-two years, and terminated by a restoration of the colony to France. Two years afterward, it was sold to the United States, and possession taken on the 30th of November, 1803. Up to that time, there had been but little Anglo-American immigration, and the population did not much exceed eight thousand. Since the transfer, forty-five years have elapsed, and the permanent population has risen, including transient persons, to more than one hundred and thirty thousand. This rapid increase has been chiefly from the United States; but England and Ireland have contributed a liberal number.

From this narrative we see, that the white population of the city consists of mixed masses of French, Spaniards, Americans, Irish, and Germans, with stragglers from England, Scotland, and Italy. There have been many intermarriages, but still the distinctive physiological characters, especially of the French and Americans, are well maintained. The Creoles are the natives, of French or Spanish parents. The negroes make a larger element of the population than either of the sub-varieties which have been mentioned; especially when we include with them the mixed races; which, under the name of mulattoes, quadroons, and griffes, are exceedingly numerous.

SECTION IV.

SMALLER TOWNS WITHIN THE DELTA.

I. Milneburg.—I do not know that even the people of this place are familiar with its name, which I copy from Springbett and Pilie's excellent map of New Orleans and its environs. It designates the port and village on Lake Pontchartrain (*Pl. VI*), where the railroad from the Third Municipality of New Orleans terminates, at the distance of six miles from the Mississippi River. In crossing the isthmus on that road, we see, that the whole was once a cypress swamp, though much of it has been redeemed by cutting down the forest and ditching the ground. Still, for two miles before reaching the Lake, the road lies through a swamp, which imperceptibly graduates into the Lake. Thus there is, or rather was, a broad margin of cypress forest, on which even the low tides of the lake ebbed and flowed, and over which the winds from the north or north-east, impel its waters. The lake is literally without any restraining banks, and its margin is so shallow, that a long wooden dock is necessary for communication with the sloops and steamers which frequent the port. The houses of the village are generally built on blocks, or earthen foundations, which have been thrown up to raise them above the waves. On this broad tidal beach, remote from any deep water, every kind of impurity is but rolled backward and forward; and taking the locality as a whole, it may be said to abound in filth, while a dark swamp lies immediately in its rear.

Of the prevalence of autumnal fever at this locality, compared with other places in the Delta, I am not informed. It has been affected with yellow fever; and it is in reference to the history of that disease that an account of its topography becomes necessary.

II. FRANKLIN.—The Tèche (*Pl. V*), one of the most beautiful bayous of the Delta, and the principal river of the ATTAKAPAS COUNTRY, has on its banks three small towns, which require to be mentioned. The lowest is Franklin, on the right bank of the bayou, in N. Lat. 29° 45′, at the head of low water steamboat navigation. Its population is four or five hundred. Its site, which rises above the highest freshets of the bayou, has in its rear the usual cypress swamps. Autumnal fever, as I learned from Doctor Hornsby, now of Plaquemine, occurs every autumn, both in the village and on the banks of the bayou above and below; but in general without any extraordinary violence. Yellow fever has invaded it, once or oftener.

III. NEW IBERIA is situated higher up the Tèche (*Pl. V*), on the same side with Franklin, at the very margin of the Delta. It stands, in fact, on the extreme margin of the high plains of Opelousas, about twenty feet above the surface of the bayou.* Its latitude is 30° N. Like Franklin, it is subject to autumnal fever, and has also been reached by yellow fever, when that disease was epidemic in New Orleans.

IV. ST. MARTINSVILLE (*Pl. V*), is the highest town up the Tèche, being in Lat. 30° 10′ N. Its site is on the right bank, and is too elevated to be overflowed by the greatest floods of the bayou; but so level, that the rains do not drain off, and the surface becomes extremely soft in wet weather † At a distance from the bayou, there are the usual cypress swamps. St. Martinsville, like the towns below, is subject to mild, endemial, autumnal fever, and has likewise experienced visitations of yellow fever.

V. THIBODEAUX.—We pass from the Tèche to the Bayou La Fourche, which leaves the Mississippi on the right hand side, one hundred and eighty-four miles from the Gulf of Mexico. The highly cultivated borders of the La Fourche, protected by levees, are limited in the rear by swamps. On one of these belts, about forty miles down the bayou, stands the village of Thibodeaux, which in its medical topography presents nothing peculiar, and would not demand a notice, but that it has suffered one or more invasions of yellow fever.

VI. DONALDSONVILLE.—This beautiful and comparatively new town, is built on the right bank of the Mississippi, in N. Lat. 30°, immediately below the efflux of the bayou which has just been described. Its site is more elevated than many others within the Delta, and does not, therefore, suffer inundation from any but the greatest floods of the Mississippi. In cleanliness, as well as dryness, it may be ranked with the best localities of the

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* Darby: Emigrant's Guide. † Ibid.

Delta; and the swamp in its rear, to the south, does not approach it as closely as the same kind of surface approaches New Orleans, and many other towns of this region. Autumnal fever prevails here, as in the surrounding localities, and sometimes assumes a malignant type. Yellow fever has made it a few visitations, but none were of a violent character.

VII. PLAQUEMINE is a respectable and well-built town, of the smaller size, situated thirty-five miles above Donaldsonville, on the right side of the Mississippi, immediately below the efflux of Bayou Plaquemine. Its site is dry, but the bayou winds closely round it, and there are, of course, cypress swamps in its rear. It suffers moderately from autumnal fever, and has experienced a few, but not very serious, invasions of yellow fever.

VIII. ANGLE OF THE DELTA.—This extends from the Bayou Plaquemine to the mouth of Red River, a distance of more than one hundred miles, and includes the important parishes of West Baton Rouge, Point Coupée, and the eastern part of Avoyelles, all in the state of Louisiana. The Mississippi, through nearly the whole length of this angle, flows close to its left bank, which is a continued tertiary bluff. The right bank is raised by a levee, which, however, does not afford full protection from overflows; for the bends in the river are here of the most remarkable kind; and consequently, from the retardation of the current, the levees are apt to give way; moreover, the banks of the Bayou Atchafalaya, which flows through the western part of the angle, are so low, that in the annual rise of the Mississippi they are deeply overflowed. Thus the settlements in this bottom are chiefly on the river bank, with a levee in front, and swamps, which generally dry up in autumn, and bayous, ponds, and lakes, in the rear. This portion of the Delta was settled by the French at an early period; and all the arable land has long been subjected to the action of the plow, and other agricultural implements, with full exposure to the rains and sun. Cotton, the former staple, has largely given place to sugar. The population of this region is entirely rural. There is not, I believe, a single town; but at the distance of fifty-five miles above Plaquemine, there is a public steamboat landing called Waterloo.

From all that I have been able to learn, autumnal fever in this portion of the Delta is generally mild and not remarkably prevalent. Doctor Thomas Beaumont, who resided, when I saw him, on the tertiary plateau, several miles from the Delta, in the parish of East Baton Rouge, assured me, that malignant cases of autumnal fever were decidedly more frequent and fatal where he then lived, than in the Delta from which he had removed; and Doctor McKelvey, of St. Francisville, informed me on the authority of Doctor G. W. Smith, who had practiced his profession on the Point Coupée coast, and also on the opposite bluffs in West Feliciana, that the fevers of autumn were milder in the former than in the latter locality. We must now ascend to the bluffs.

SECTION V.

TOWNS ON THE BLUFFS OF THE DELTA.

Every locality described in the preceding Sections of this Chapter, lies *within* the Delta, has an alluvial surface, and rises but a few feet above the river. Having traveled over the whole of that peculiar region, we must now ascend to the towns which have been built upon its bluffs, beginning with its right hand, or south-western side. The bank or bluff which constitutes the boundary of the upper part of the Delta in that direction, rises thirty or forty feet above the river and its bayous; and stretching off as a plain, on which there are many extensive prairies, constitutes the Opelousas Country. I am informed by Professor Forshey, of Vidalia, that this plain is a bed of diluvium or drift, having in its rear a higher tertiary formation, covered with pine forest.

I. Opelousas.—The position of this town, and its distance, (about five miles), from the navigable bayous of the Delta, may be seen in *Pl. V.* In the absence of any later description, I shall transcribe from Darby, * the following topographical notice:

"The neighborhood of Opelousas church is a kind of table land, from which the waters flow as from a common center. Without reference to a good map, it is very difficult to explain the very complicated structure of this country. The water-courses are interwoven into each other, with an intricacy that demands much attention to comprehend with precision. Three miles north-west of Opelousas church, there is, surrounded by prairie, a body of woods two miles long, and a half a mile wide. This isolated forest is not unaptly called Isle au L'Anglais. The denomination of island is not unappropriate when applied to a copse standing in a sea of grass.

"From the east side of this island, flow the head waters of the Mermentau. The source of the river is an extensive, low, wet plain. The water gradually collects into a single channel, which passes to the southward, within less than a mile of Opelousas church; and continuing that course about three miles, divides; one part running eastward into Bayou Bourbée, contributes to form the Vermillion; the other runs south-west, into Bayou Plaquemine Brulée, and finally into the Mermentau River.

"Three miles north of Opelousas court-house, the drains of the prairie are connected; part of the water flows north, into Bayou Grand Louis, and the other, south, forming the head of Bayou Bourbée."

Of the prevalence of autumnal fever at Opelousas, I cannot speak with any certainty, and have been led to introduce a notice of its topography, because it has suffered from yellow fever.

II. Baton Rouge.—That portion of the Delta which lies above Bayou Plaquemine, on the west, and Bayou Iberville or Manchac, on the east, has

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* Emigrant's Guide, 1818.

been already designated as its angle. The plains of Opelousas, as we have just seen, constitute its boundary in the former direction; in the latter it is terminated by the tertiary formation, which stretches westwardly from Mobile Bay, and reaches the Delta, a short distance above the Bayou Iberville, not far below Baton Rouge. It is common to speak of the site of this town as the first high land, on which the eye rests in ascending the Mississippi; which here, instead of keeping out in the middle of the Delta, presses hard upon the bluffs. When the observer, standing upon the bluffs, looks off to the west, he sees, on the opposite side of the river, a low, wet, and level bottom, with its levee, and belt of cultivated ground graduating into cypress swamps, which extend, with the interruptions occasioned by the Atchafalaya and other streams of the Delta, quite across to the terrace of Opelousas. From this broad paludal surface, every westerly wind transports to the bluffs whatever exhalations may arise. But we must fix our attention upon the town.

Baton Rouge, standing on the bluff which has been described, in N. Lat. 30° 36′ and W. Lon. 91° 33′, is distant from New Orleans one hundred and forty miles — from the Balize two hundred and forty-four. The elevation of its site is about twenty-two feet above high water-mark of the river; but such is the close approximation of the land and water surfaces to the same level throughout the Delta, that he who has sojourned upon it for awhile, will, on approaching this bluff, regard it as much higher than it really is. * The town plat is free from ponds and marshes; but I observed, in a short excursion on the plain behind it, that the rain water does not readily sink into the ground, and is retained on the surface by its levelness. To the south, down the river, there is a narrow, cultivated bottom, some portions of which are overflowed in times of high water. To the north, and adjoining the town, there is a small tributary, up which the waters of the Mississippi are backed, when the river is high; but Doctor R. F. Harney, U. S. A., assured me, that the silt then deposited is washed away, by the copious rains which, in summer, follow on the subsidence of the freshet. Up the river, the nearest swamp is fifteen miles. †

When visiting Baton Rouge, in 1844, I was informed by Doctor French, who had resided there more than thirty years, and also by Doctor Harney, who had been stationed there for the greater part of a quarter of a century, that, in reference to intermittent and remittent fever, Baton Rouge cannot be regarded as unhealthy; and, as far as the people of the town are con-

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* I have been told, that horses reared in the lower part of the Delta, and always accustomed to a level surface, have shown great awkwardness and some difficulty, in attempting to ascend the bluffs, when brought to them, as they occasionally have been; a fact which strongly illustrates the flatness of that surface, and one of its physiological effects.

† Med. Stat. U. S. A. p. 253.

cerned, I know of no facts which contradict their assertions. It has several times, however, been visited by yellow fever.

Military Post.—In the year 1819, the Government began the erection of barracks on the bluff, adjoining and above the town, and for the first six years, the soldiery suffered more from sickness than at any other post in the United States; which, of course, was charged upon the local situation. Doctor Harney, however, ascribes their sickness and mortality to the following causes: *First.* They were recruits from the north. *Second.* They were extremely intemperate. *Third.* For the purpose of building barracks, they were obliged to fell trees in a cypress swamp, fifteen miles above the town; in doing which they were greatly exposed to the direct action of the sun and rains.* In latter years, as Doctor Harney assured me, the soldiers are much healthier. The army returns, for seven years, between 1829 and 1839, give for intermittent fever a ratio of fifty-one per cent., and for remittents of thirty per cent. These ratios, Doctor Forry, the editor, remarks, are not beyond those of some other posts, but the proportion of fatal cases was greater than at any other; the remittents often assuming a most malignant type.

Baton Rouge was settled almost as far back as New Orleans; and until the cession of Louisiana to the United States, in 1803, its population was chiefly French and Spanish. Soon afterward, emigrants from the United States began to flock thither, and to other places in that region; but Spain kept possession of the whole until 1810, alleging that it was a part of West Florida.† At present, although it has a mixed population, the American greatly predominates over all the rest. The town, as we have seen, is the site of a permanent military post; the penitentiary of the state has been erected here; and lately the legislature of Louisiana has fixed upon it as the future capital of the state. Thus, although not a commercial town, its military, civil, and political importance, entitles it to the attention of the medical historian.

III. Port Hudson.—This inconsiderable village, with a population of eighty or one hundred, situated twenty-five miles above Baton Rouge, is a landing place for East Feliciana and other parishes of that part of Louisiana. From Doctor Beaumont I have learned, that it stands on a high bluff, at the foot of which the river flows. Just above the village, there is an extensive swamp between the bluff and river, and below some smaller swamps and ponds. It experiences an annual visitation of autumnal fever, like other places in the South; but the chief reason for introducing a notice of it here, is, that it has repeatedly suffered from yellow fever.

IV. Bayou Sara, and St. Francisville.—These adjoining towns are

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* Medical Statistics, U. S. A.

† Pitkin's Stat. Views of the United States, p. 17.

situated ten miles above Port Hudson, in the parish of West Feliciana. The former stands on a bottom of moderate width; the latter, immediately behind it, on a tertiary bluff, about eighty feet in hight. The site of Bayou Sara is elevated, in front, above high water-mark of the river; its back part is liable to partial inundation when the river is swollen. The water then makes its way upon this portion of the town by two routes. On the west, the alluvial plain, about half a mile in width, sinks into a cypress swamp, up which the spring floods of the Mississippi creep upon the town plat. To the east, is the creek called Bayou Sara, out of which the back water of the river flows upon the same portions of the town site. Immediately above this bayou, there is a low cotton-wood bottom, which is annually overflowed to the depth of several feet. Bayou Sara is a landing place of considerable business; being the terminus of a railroad to Woodville, in the state of Mississippi.

St. Francisville lies to the north north-east of Bayou Sara. The dry, loamy terrace on which it stands, abounds in grey sand; in which, to the east and west of the town, are deep ravines. The wet bottom or swamp below Bayou Sara, lies to the south-east of St. Francisville; and the inundated cotton-wood bottom already mentioned, to its north-west. Thus its south-east and south-west winds pass over swamps. In its rear, there are branches of the Bayou Sara, and another stream called Anderson's Creek, flowing in ravines; beyond which, the country attains a higher elevation, and is somewhat broken.

Both these towns are liable to autumnal fever, from which the upper seems to have suffered more than the lower; and both have experienced epidemic invasions of yellow fever.

SECTION VI.

AN EARLY VOYAGE UP THE MISSISSIPPI.

With the preceding Section, our survey of the Delta of the Mississippi and its banks was finished. From the Balize to the mouth of Red River, we found ourselves in the midst of a highly cultivated region, and a numerous population; we saw the river and its great bayous restrained by artificial embankments; the cypress with its long moss superseded by the orange, fig, and various flowering shrubs; the natural cane-brakes replaced by fields of sugar-cane; swamps and marshes drained by the labors of art; and the very drift-wood arrested in its descent to the Gulf, and converted into fuel for the propulsion of steamboats, almost as numerous as the floating trees. We are now about to ascend the river, and observe the hygienic condition of its bluffs and bottoms, above the Delta; but before departing, I propose to offer, as an interlude, some extracts from the narrative of an early voyage, from New Orleans to the Arkansas river. It was performed by the Jesuit Father Du Poisson, one hundred and twenty years ago, and consequently but nine years after the first settlement of the city. The reading of it will not only relieve the tedium of topographical description; but, by showing the condition of the river and its banks, while in a state of nature, will enable us to estimate more fully the transformations which civilization has effected.

VOYAGE OF DU POISSON.*

"We embarked on the 25th of May, 1727, the Fathers Souel and Dumas with myself, under the direction of the good man Simon. The Fathers de Guienne and le Petit, being obliged in a few days to take a different route; the former, as you know, to the *Alibamons*, and the latter to the *Chasses.* Our baggage and that of our boatmen occupied a space, which filled up our two boats to more than a foot above the sides. We were perched up on a heap of chests and packages, without being able even to change our position, and it had already been prophesied to us that we could not go far with this equipage. In ascending the Mississippi we coasted along by the shore in consequence of the force of the current. We had scarcely lost sight of New Orleans, when a projecting branch which had not been noticed by our helmsman, caught in a chest, overturned it, caused it to make a somerset upon a young man who was near, and rudely struck Father Souel. Fortunately it broke in this first effort, or both the chest and the young man would have been in the river. This accident decided us, when we arrived at Chapitoulas, about three leagues distance from New Orleans, to dispatch some one to Father de Beaubois, to ask him for a much larger boat.

"During all this time we were among old acquaintances. The barbarous name which the country bears, shows that it has been in other times inhabited by savages, and at present they apply this title to five grants which are along the Mississippi. M. Dubreuil, a Parisian, received us into his. The next three belong to three Canadian brothers, who came into the country to settle, with nothing but the clothes on their back and the stick in their hand, but who have more advanced their fortunes than the grantees in France, who have sent out millions to establish their grants, which at the present time are for the most part ruined. The fifth belongs to M. de Koli, a Swiss by birth, Seigneur of the Manor of Livry, near Paris, one of the most honorable men that can be found. He had come over in the same ship with us, to see for himself the condition of his grant, for which he had fitted out ships, and subjected himself to endless expenses. There are in each of these grants at least sixty negroes, who cultivate Indian corn, rice, indigo, and tobacco. These are the parts of the colony which are most flourishing. I now am speaking to you of a grant; I shall also have occasion presently to speak of a plantation and a settlement. You perhaps do not know what all these are; have patience then to read the explanation.

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* Early Jesuit Missions in North America: Trans. by the Rev. W. J. Kip; Part II, p. 232—252.

"They call a *Grant* a certain extent of territory *granted* by the India Company to one person alone, or to many who have formed together a partnership to clear the lands and make them valuable. These were the persons, who in the days of the great Mississippi bubble * were called the Counts and the Marquises of Mississippi. Thus the grantees are the aristocracy of this country. The greater part have never left France, but have equipped ships filled with directors, stewards, storekeepers, clerks, workmen of different trades, provisions and goods of all kinds. Their business was, to penetrate into the woods, to build their cabins there, to make choice of lands, and to burn the canes and trees. These beginnings seemed too hard to people not accustomed to such kind of labor; the directors and their subalterns for the most part amused themselves in places where there were some French already settled; there they consumed their provisions, and the work was scarcely commenced before the grant was entirely ruined. The workman badly paid, or badly fed, refused to labor, or else seized on his own pay, and the stores were plundered. Was not all this perfectly French? But this was in part the obstacle which has prevented the country from being settled, as it should have been, after the prodigious expense which has been lavished upon it.

"They call a Plantation a smaller portion of land granted by the company. A man with his wife, or his associate, clears a small section, builds him a house with four forked sticks, which he covers with bark, plants some corn and rice for his food; another year he raises more provisions, and begins a plantation of tobacco, and if finally he attains to the possession of three or four negroes, behold the extent to which he can reach. This is what they call *a plantation* and *a planter*. But how many are as wretched as when they commenced?

"They call a Settlement, a section in which there are many plantations not far distant from each other, forming a kind of village.

"Besides these grantees and planters, there are also in this country, people who have no other business than that of vagabondizing. *First*, Women and girls taken from the hospitals of Paris, from Salpêtriére, or from other places of equally good reputation, who find the laws of marriage too strict, and the care of a single household too troublesome. Voyages of four hundred leagues present nothing to terrify these heroines; I have met with two of them, whose adventures would furnish materials for a romance. *Second*, The voyagers; these are for the most part young people sent for some reason to the Mississippi by their parents or by justice, and who, finding it too low to dig the earth, prefer engaging themselves as rowers, and wandering about from one shore to the other. *Third*, The hunters; these at the end of the summer ascend the Mississippi to the distance of two or three hundred leagues to the buffalo country; they dry in the sun the flesh on the ribs of the buffaloes,

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* Of Law, the Scotch financier in Paris.

salt the rest, and also make bear's oil. Towards spring they descend, and thus furnish provisions to the Colony. The country which extends from New Orleans even to this place, renders this business necessary, because it is not sufficiently inhabited, or enough cleared to raise cattle there. At the distance of only thirty leagues from here they begin to find the buffaloes, and they are in herds on the prairies or by the rivers. During the past year a Canadian came down to New Orleans with four hundred and eighty tongues of buffaloes he had killed during his winter campaign with the aid of only one associate.

"We left the *Chapitoulas* on the 29th. Although we had sent for a much larger boat, and in spite of the new stowing which our people made, we were almost as much crowded as before. We had but two leagues to make that day, to reach *Burnt Canes*, the residence of M. de Benac, director of the grant of M. d'Artagnan, where we were to sleep. He received us in a very friendly manner, and regaled us with a carp from the waters of the Mississippi, which weighed thirty-five pounds. The *Burnt Canes* is the name given to two or three grants along the Mississippi; the place is very much like the *Chapitoulas*, while the situation appears to me to be more beautiful.

"The next day we advanced six leagues, which is about as much as they can ever accomplish in ascending the river, and we slept, or rather encamped, at *the Germans*.* These are the quarters assigned to the lingering remnant of that company of Germans who had died of misery, some at the East, and some on arriving in Louisiana. Great poverty is visible in their dwellings. It is here properly that we begin to learn what it is to voyage on the Mississippi; and I am going to give you a little idea of it, so that I shall not be obliged to repeat the same thing every day.

"We had set out at the season of the heavy floods, when the river had risen more than forty feet above its ordinary level, and as almost all the country is composed of low lands, it was of course inundated. Thus we were exposed to the difficulty of not finding *cabanage*, that is to say, ground on which to do our cooking and to sleep. When we could find it we slept in this way. If the ground was still muddy, as was the case when the water began to subside, they commenced by making a couch of branches, that the matress might not rest on the mud. Then they spread upon the earth a skin, or a matress, and clothes, if they had them. They bent three or four canes into a semicircle, both ends of which they fixed in the earth, and placed them at proper distances from each other, according to the length of the matress; on these they fasten three others crosswise, and then spread over this slight framework the *baire*, that is, a large cloth, the ends of which they fold under the matress with great care. It is under these tombs, where we are stifled with heat, that we are obliged to sleep. The first thing we do on

* German Coast.

reaching land, is to arrange our *baire* with all diligence, for otherwise the musketoes do not permit us to use it. If one could sleep in the open air, he could enjoy the coolness of the night, and would be too happy.

"There is much more cause of complaint when no *cabanage* can be found. Then they tie the boat to a tree. If they can find a raft of trees, they do their cooking on top of it, but if not, we go to sleep without supper, or rather we neither sup at all nor sleep at all, since we are resting in the same situation in which we were during the day, with the addition of being exposed through the whole night to the fury of the musketoes. By the way, what is here called a raft is a collection of floating trees which the flood has uprooted: the current continually sweeping them down, they are finally arrested by some tree whose root is in the ground, or by a neck of land, and there accumulate one upon the other, and form enormous piles. We have found some which would furnish the whole of your good city of Tours with wood for three winters. These places are difficult and dangerous to pass. It is necessary to sail close to these rafts; the current there is rapid, and if it dashes the boat against the floating trees, it disappears at once, and is swallowed up in the waters under the raft.

"It was also the season of the most excessive heats, which increased each day. During the whole voyage we had but a single entire day of cloudy weather, always the burning sun upon our heads, without being able even to use over our boats a small awning which might afford us a little shade. Besides, the hight of the trees and the denseness of the woods, which through all the route, are on both banks of the river, did not permit us to feel the least breath of wind. Although the river is a half league in breadth, the breeze does not make itself felt except in the middle of the stream; and it is necessary to cross it, to catch the slightest breath of air. We drew up, without cessation, the water of the Mississippi through reeds, to quench our thirst, and although it is very turbid, we experienced no ill effect. Another refreshment we had, was from the grapes hanging almost everywhere from the trees; and we snatched them in passing, or gathered them when we landed. There are in this country, at least among the Akensas, two kinds of grapes, of which the one ripens in summer, and the other in autumn. They are of the same species; the grapes themselves are very small, and they afford a juice which is very thick. There is also another kind, the cluster of which has but three grapes, which are as large as the damask plum. Our Indians call them *asi*, *contai*: raisin, prune.

"Our stock of provisions consisted of biscuit, butter which was salt and very rancid, rice, corn, and peas. The biscuit gave out when we were a little above Natchez. Our butter was gone when we were only ten or twelve leagues distant from New Orleans; we therefore fed on the peas, and afterwards on the rice, which did not fail until our arrival at this place. The seasoning consisted of salt, bear's oil, and a particularly good appetite. The most ordinary food of this country, almost the only food of many persons, and above all of the voyagers, is the *gru*. They bruise the corn to remove the outer skin, boil it for a long time in water, the French sometimes seasoning it with oil, and this constitutes the *gru*. The Indians pound the corn very fine, cook it sometimes with fat, but oftener with water only, and this is the *sagamite*. The *gru*, indeed, is used instead of bread; a spoonful of *gru* and a small piece of meat are taken together.

"But the greatest torment, in comparison with which all the rest would be but sport, which passes all belief, and has never been imagined in France, still less actually experienced, is that of the musketoes — the cruel persecution of the musketoes. The plague of Egypt, I think, was not more cruel — "I will send swarms of flies upon thee, and upon thy servants, and upon thy people, and into thy houses; and the houses of the Egyptians shall be full of swarms of flies, and also the ground whereon they are." They have here the *frape d'abord*, and also the *brulots*. The latter is a species of very small gnat, whose sting is so sharp, or rather so burning, that it seems as if a spark of fire had fallen on the spot. There are also the *moustiques*, which are like the *brulots*, with the exception that they are much smaller, so that one can with difficulty see them; their attacks are particularly directed against the eyes. There are also the *guepes*, and the *thon;* in one word, there are *omne genus muscarum*.

"But none of these others are worthy to be mentioned with the musketoes. This little insect has caused more swearing since the French have been in Mississippi, than had previously taken place in all the rest of the world. Whatever else may happen, a swarm of these musketoes embark in the morning with the voyager. When they pass among the willows or near the canes, as very often takes place, a new swarm fastens with fury on the boat, and never quits it. It is necessary to keep the handkerchief in continual exercise, and this scarcely frightens them. They make a short circuit, and return immediately to the attack. The arms become weary much sooner than they do. When we land to take dinner, which is between ten o'clock and two or three, there is an entire army to be combatted. We make a *boucane*, that is, a great fire, which we stifle afterwards with green branches. But it is necessary for us to place ourselves in the very thickest of the smoke, if we wish to escape the persecution, and I do not know which is worse, the remedy or the evil. After dinner we wish to take a short nap at the foot of a tree, but that is absolutely impossible; the time allotted to repose is passed in contending with the musketoes. We embark again in their company, and at sunset, on landing, it is necessary immediately to run to cut canes, wood, and green branches, to make the *baire*, the fire for cooking, and the *boucane*. There, it is each one for himself; but it is not one army, but many armies which we have to combat, for that time of day belongs to the musketoes. One is perfectly eaten and devoured. They get into the mouth, the nostrils, and the ears; the face, the hands, the body are all covered; their sting penetrates the dress, and leaves a red mark on the flesh, which swells on those who are not as yet inured to their bite. Chicagon, to enable some of his nation to comprehend what a multitude of French he had seen, told them, that he had beheld "as many in the great village" (at Paris) "as there were boughs on the trees, *and musketoes in the woods.*" After having supped in haste, we are impatient to bury ourselves under the *baire*, although we know that we go there to be stifled with the heat. With what address, with what skill does each one glide under his *baire!* But they always find that some have entered with them, and one or two are sufficient to insure a miserable night.

"Such are the inconveniences of a voyage on the Mississippi. And yet how many voyagers endure them all for the prospect of a gain even the most moderate! There was in a boat which ascended at the same time with our own, one of those heroines of whom I have already spoken, who was going to rejoin her hero. She did nothing but chatter, laugh, and sing. And if for a little temporal benefit, if even for crime itself, one can endure a voyage like this, should men fear it who are appointed to labor for the salvation of souls!

"I return to my journal. On the 31st, we made seven leagues. In the evening, no cabanage. Water and biscuit for supper — slept in the boat — devoured by the musketoes through the night. *Note.*— This was the Vigil of Whitsunday, a fast-day.

"The 1st of June we arrived at Oumas, a French plantation, where we found enough ground not overflowed to erect our cabins. We remained there during the next day to give rest to our crew. In the evening, Father Dumas and I embarked in a boat which during the night was to go the same distance we should otherwise have to accomplish on the next day. By this means we avoided the intense heat.

"On the 3d, we arrived, early in the morning indeed, at *Bayagoulas* (the destroyed nation), at the house of M. du Buisson, director of the grant of Messieurs Paris. Here we found some beds, which we had almost forgotten how to use, and during the morning took that repose which the musketoes had not permitted us to gain during the night. M. du Buisson omitted nothing which could add to our comfort, and regaled us with a wild turkey. (This is in every respect like the domestic turkey, except that the taste is finer.) The grant appeared to us well arranged and in a good condition. It would have been worth still more if it had always had as good a director. Our people arrived in the evening, and the next day we left the *Bayagoulas*, charmed with the pleasant manners and civilities of M. du Buisson.

"In the evening we arrived at a spot above the *Manchat*,* a branch of the Mississippi which empties into the Lake *Maurepas;* no ground for cooking, — no cabanage — millions of musketoes during the night. *Second Note.* This was a fast-day; the waters began to fall, which gave us reason to hope that we should not be obliged to sleep much more in the boat.

* Bayou Iberville.

"On the 4th we slept at *Baton Rouge.* This place receives its name from a tree painted red by the Indians, and which serves as a boundary for the hunting grounds of the nations who are above and below. We saw there the remains of a French plantation, abandoned on account of the deer, the rabbits, the wild-cats, and the bears, which ravaged everything. Four of our people went on a hunting expedition, and returned next day without any other game than an owl.

"On the 7th we dined at the grant of M. Mezieres: it has the air of a plantation which is just commencing. We saw there one hovel, some negroes, and a single laborer, who did us neither good nor ill. We cabined for the night at *Point Coupée*, before the house of a planter, who received us with great attention. The rain detained us there next morning, and permitted us during the whole day to make but a single league, as far as the residence of another planter. His house, which was constructed from four forked sticks, gave us, for better and for worse, a shelter from a frightful storm. How much need have these poor people of consolation, both spiritual and temporal!

"On the 9th we had scarcely embarked when there came from the woods a most execrable odor. They told us that it proceeded from an animal close on shore, which they called *bête puante* and which spreads this disagreeable smell everywhere about it. We cabined for the night at the *Little Tonicas*, in the canes; during the winter they set them on fire, but during the summer it is necessary to cut them to be able to cabin there. The Indian village is up the country; from thence to the *Great Tonicas* it is ten or twelve leagues by the Mississippi; but by land there is nothing but a mere neck which separates the two villages. Formerly they made a portage, crossing the land. They still call this passage *the portage of the Cross*. The river had penetrated this point, and inundated it entirely during these great floods, and it was this place that we had to cross the next day, that is to say, a distance of two leagues, to avoid the ten leagues which it would be necessary to go if we continued our route by the Mississippi. We accordingly took an Indian at the *Little Tonicas* to act as our guide.

"On the 10th we entered these woods, this sea, this torrent, for it is all these at once. Our guide, whose language none of us understood, addressed us by signs; one interpreted these in one way, and another in a different way, so that we did everything at hazard. However, when a person has entered these woods, it is necessary to go on or perish; for if he allows himself to get into the current for the purpose of returning, the rapid stream will certainly dash the boat against a tree, which will break it into a thousand pieces. If it had not been for that, we should have retired from such an evil undertaking immediately, as soon as we saw ourselves embarked in it. It was necessary unceasingly to turn about the boat in a zigzag course to prevent the bows from striking against the trees; and we often found it wedged between two trees which did not give it sufficient space to pass, contrary to the expectation of those who steered it. Now there was a torrent of which the entrance was almost closed by a raft, or perhaps by two trees of great length and enormous thickness, prostrated across the two banks of the current, and which rendered it more impetuous; now, the entrance would be entirely barred by a single tree, and it was necessary to change our direction at the risk of finding the same obstacle a moment afterward or of not finding sufficient water, but instead of it, mud and brambles. Then, it became necessary to push on the boat by main strength. Often one of our people was obliged to spring into the water even to his neck, to go and make fast the boat to a tree which extended out, so that if the strength of the current should exceed that of the oars, and cause the boat to recede, it might not dash itself against a tree. Our own boat ran the greatest risk; it began to fill in a current which had forced it back, and we saw in a moment that it was going to sink. The strength of the oars saved us, and by good fortune there happened not to be at that place either raft or uprooted trees. After having passed another, which only left a space the size of the boat, it remained for a moment immovable between the strength of the current and that of the oars; we did not know whether it was going to advance or be driven back, that is to say, for a moment we were vibrating between life and death; for if the oars had yielded to the strength of the current, we should have gone back to be dashed against a large tree which almost entirely barred the current. Our people in the other boat, who had passed before us, waited in a sad and mournful silence, and uttered a loud cry of joy when they saw us out of danger. I should never end if I were to recount to you all the toils of this day. The passage is well named *the passage of the Cross*, and a voyager who knows what it is, and does not decline attempting it, even if he should escape its dangers, merits a place in a madhouse. And by this side cut they abridge the voyage but a very short day's sail. The Lord saved our lives, and we at last reached the end and succeeded in accomplishing these two fatal leagues.

"We arrived then at four or five in the evening at the *Great Tonicas*. The chief of this nation came to the bank of the river to receive us, grasped our hands, embraced us, spread out a mat and some skins before the cabin, and invited us to sleep there. Then he presented us with a large plate of blackberries, and a *manne* (that is, a basket) of green beans. It was truly a feast for us; for the *passage of the Cross* had not permitted us to stop for dinner.

"On the 11th we passed the night for the last time in the boat. On the 12th we cabined at *Ecors blancs*, and on the 13th at *Natchez*. We immediately made our visit to the Reverend Father Philibert, a Capuchin, who is the Curé. He is a man of good sense, who was not frightened at seeing us, as his brethren had been at New Orleans; in other respects, he is a man of worth and very zealous. We afterward descended to the bank of the river *to make there our baires*.

"The French settlement at Natchez has become very important. They raise there a great deal of tobacco, which is esteemed the best in the country.

"We left Natchez on the 17th, and embarked, the Father Dumas and myself, in a boat which went out on a hunting expedition. Our people had not yet prepared their provisions, that is to say, they had not purchased and pounded their corn.

"As the flats now began to be seen, we found there the eggs of the turtle, which were a new feast for us. These eggs are a little larger than pigeon's eggs, and are found in the sand of the flats, where the sun hatches them. The tracks which the turtles leave, enable us to discover the places where they have concealed their eggs. They are found in great quantities, and are made into omelettes, which are much relished by people who are accustomed to eat nothing but *gru*.

"They reckon the distance from New Orleans to Natchez at nearly a hundred leagues, and from Natchez to *Yatous*,* at forty. We made this second passage without any other adventure, except that during one night we were overtaken by a violent storm, accompanied with thunder and lightning. You may judge whether a person is well protected from the rain under the covering of a single cloth. The next day an Indian who was ascending the river with us went on shore for the purpose of hunting. We continued our route, but had scarcely gone half a league when he appeared on the bank with a deer on his shoulders. We therefore cabined on the first flat we came to, for the purpose of drying our clothes and making a great feast. These repasts, which take place after a good chase, are perfectly savage in the way they are conducted, though nothing can be more pleasant. The animal is in pieces in a moment; nothing is lost; our voyagers place it on the fire or in the pot, each one according to his taste; their fingers and some little sticks supply the place of all kinds of utensils for cooking and for the table. To see them covered only with a cloth round the loins, more athletic, more browned than the Indians themselves, stretched out on the sand or squatting down like monkeys, and eating what they hold in their hands, one can scarcely know whether it is a troop of gypsies, or of people who are assisting at a witch festival.

"On the 23d we arrived at *Yatous*, a French post within two leagues of the mouth of the river of that name, which empties into the Mississippi. There is an officer with the title of Commander, together with a dozen soldiers, and three or four planters. The grant of M. le Blanc was at this place, but it has gone to ruin like the others. The ground is elevated by mounds; little of it is cleared, and the air is, they say, unwholesome. The Commander, in honor of our arrival, fired off all the artillery of the fort, which consists of two pieces of very small cannon. The fort is a barrack in

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† Yazoo River.

which the Commander lodges, surrounded by a single palisade, but well defended by the situation of the place. He received us in a very friendly way, and we cabined in his court-yard.

"On the 26th we reëmbarked, the Father Dumas and myself. From Yatous to the Akensas they reckon the distance at sixty leagues. We arrived there on the 7th of July, without any other adventure than having made a great feast of bear's meat, which one of our people had procured in the chase.

"After having walked about the eighth of a league, we arrived at the French dwellings. I was lodged in the house of the Company of the Indies, which was that of the Commander when he is here, and found with great satisfaction that I was at the end of these two hundred leagues which I had to accomplish. I would rather twice make the voyage which we had just finished on the sea at the same season, than to recommence this one. The Father Dumas was only in the middle of his route to go to the Illinois, and embarked again on the morning after his arrival; from this place to the Illinois country he did not find a single habitation, but they scarcely ever failed to kill some buffaloes, which very well made amends to people who had nothing to live on but some *gru*.

"I have now reached the end of my long and tedious narrative."

CHAPTER VI.

THE SOUTHERN BASIN, CONTINUED.

MEDICAL TOPOGRAPHY OF THE BOTTOMS AND BLUFFS OF THE MISSISSIPPI RIVER, ABOVE ITS DELTA.

In continuing to ascend the Mississippi, or great synclinal axis of the Interior Valley, it will facilitate the study of its medical topography and hydrography to divide it into natural sections, the limits of which may, on the whole, be tolerably well defined. The following are the divisions which it will be convenient to make—

The Tensas, or Concordia bottom,
The Yazoo bottom,
The St. Francis bottom,
The American bottom,
The Upper Mississippi.

SECTION I.

THE TENSAS OR CONCORDIA BOTTOM.

This Bottom, with but little modification of character, extends from the mouth of Red River to the diluvial bluffs, in the rear of the town of Helena, about ninety miles above the mouth of Arkansas River. It lies entirely on the western side of the Mississippi, and is about five hundred miles long. Its range of latitude is from thirty-one to thirty-four and a half degrees north. In general its lower half is wider than its upper, except where the Arkansas and White Rivers traverse the latter.

Through its whole length, near the Mississippi, there are beautiful crescent-shaped lakes, the obsolete beds of large bayous or divisions of the river, if not of the whole stream. These, and many other lakes, lagoons, and extensive swamps, are, every spring and early summer, replenished with water; for although levees have been thrown up, they never wholly prevent an inundation. There are, moreover, some other sources of supply, which must not be overlooked. *First.* Water escapes from the Arkansas River into this Bottom. *Second.* It is traversed by the Washita, which descends upon it from the highlands to the west, and often overflows its banks. *Third.* When the Mississippi is swollen, its waters flow up Red River, and then ascend Black River, the Washita, and other streams which originate in the Bottom, and thus effect an overflow of its southern portion. By the same outlet, when the great river subsides, a large portion of the diffused water is drained off. Thus the river Bœuff has its origin in the largest and most northern of the lakes, called Villemonts, an old river, and discharges its waters into the Washita. Further down we have the origins of the river Tensas, which, as it flows to the south, is reinforced from Lake Providence, Lake Joseph, Lake Concordia, Lake Lovelace, and many smaller lakes and streams, before it unites with the Washita. Near their junction, the outlet of Catahoola Lake, lying to the west, likewise enters the Washita, after which the common trunk, under the name of Black River, discharges its waters into Red River, thirty miles from the Mississippi. Thus, while none of the water which escapes laterally from the bed of the Mississippi, below the mouth of Red River, ever returns, but reaches the Gulf by new channels which traverse the Delta; that which leaves the Mississippi between Arkansas and Red Rivers, is restored to the parent stream through the latter; after having inundated the Concordia Bottom. The levees designed for the protection of this Bottom, can never be as effective as those within the Delta. The range between high and low-water marks is much greater; and hence, when the river is falling, the saturated banks, lashed by the waves produced by winds and steamboats, crumble in and carry with them portions of the levee. The materials of which the levee is formed are, moreover, less argillaceous and adhesive, and therefore more readily give way under the pressure of water. Thus, this long and otherwise exceedingly valuable tract of alluvion, is not likely to sustain a dense population, or to be relieved from the consequences, to health, of a yearly inundation.

The eastern boundary of this Bottom is the Mississippi; its western, as Professor Forshey informed me, is a diluvial terrace, beyond which rises a higher tertiary or cretaceous plain, covered with pine woods. That gentleman has published a map of the long parish of Concordia, extending from the mouth of Red River to a point nearly opposite Vicksburg, which beautifully illustrates the hydrography of this Bottom, by displaying its labyrinth of lakes, bayous, and cypress swamps. A section of this map, opposite the city of Natchez, constitutes *Pl. VII.*

Nearly all the redeemed and habitable land of this Bottom is found along the Mississippi, the larger bayous, and the numerous crescentic lakes. The population is altogether rural, and the staple of agriculture, cotton. The few villages which are scattered here and there, are of limited population, and can scarcely be regarded as diversifying the condition or character of its inhabitants.

In ascending the Mississippi from Red River, we have, first, *Vidalia*, opposite Natchez; then *Columbia*, sixty miles below the mouth of Arkansas River; *Napoleon*, higher up; and lastly, *Helena*, at the head of the Bottom, ninety miles above Red River. Of the first, something may be said when describing Natchez. The second is the largest of the whole, but I have not the materials for a description. The last two are so inconsiderable in size as not to merit special notices, even if I could give them.

Settled long since the Delta, the inhabitants of the Concordia Bottom are chiefly Americans; and the plantations are much newer than those of the coast below. To this cause, in part, at least, it may be owing that, although further north, they are decidedly more liable to autumnal fever (including malignant cases) than the people of the Delta. The plantations which have been longest cultivated are the healthiest. The most salubrious are those on the margin of the Mississippi, and its obsolete beds, the crescentic lakes. Yellow fever, I believe, has never invaded these plantations.

SECTION II.

THE TENSAS BOTTOM CONTINUED — LOCALITIES ON ITS BLUFFS.

Of the bluffs on the western side of the Tensas Bottom, I know too little to venture on a description; which, however, is not particularly required, as their population is sparse; but those on the eastern side, support several flourishing towns, which are of decided interest to the topographical etiologist. These bluffs, as we ascend the Mississippi from Bayou Sara, described on page 111, increase in hight until we reach Vicksburg, and are everywhere composed of loose tertiary deposits, which the river undermines and washes away. From their summits the Concordia Bottom presents a vast grove of cypress, liquidambar, and other forest trees, with a range of cotton fields on the right bank of the river. In describing their localities, I shall begin with that which lies furthest down the river.

I. Fort Adams.—This village, as its name imports, was formerly a military post, but is now an important steamboat landing, with a population of three hundred souls. It stands seventy miles above Bayou Sara, and twelve above the mouth of Red River. The Mississippi at this place approaches so near the bluffs, that many of the houses are built on its rugged declivity; the rest being near the water's edge. Of the liability of this place to autumnal fever I cannot speak; and have introduced this notice because it has suffered from yellow fever.

II. Natchez.—No city in the Mexican or Southern Basin has had as many able medical historians as Natchez. Since Commissioner Andrew Ellicott sojourned there, through the summer of 1797, and made the first report on its diseases, * we have had Doctor Perlee, † Doctor Tooley, ‡ Doctor Cartwright, || Doctor Merrill, § and Doctor Monette, ¶ who may be considered as having exhausted the subject. The causes of its having received so much attention are, its early settlement and former political and commercial distinction, together with its frequent and fatal invasions by yellow fever.

Natchez (*Pl. VII*) is situated in N. Lat. 31° 33′ 37″, and W. Lon. 91° 28′ 22″. The elevation of its site, according to Mr. Nicollet, is two hundred and sixty four feet above the sea, and one hundred and seventy-eight above the river at low water; which, consequently, is eighty-six feet above the Gulf of Mexico. In approaching Natchez the Mississippi flows nearly to the south, and when opposite turns to the west. The streets which rest upon the river, run to the south-east, and are intersected by others at right angles. The first of the latter class is not on the margin of the bluff, and thus there is, between that margin and the city plat, a promenade or narrow commons. The terrace on which the city is built, consists of alternate layers of tertiary sand and clay, with deposits of oceanic shells, the whole surmounted with a stratum of loamy marl, containing the *debris* of plants. Well-water cannot be obtained by digging into these strata, and hence, the water used by the inhabitants is, either, from the river, or out of cisterns filled during the rainy season.** The surface originally rugged, has, however, been leveled by art; an enterprise which required a great deal of excavation and filling up.†† The country immediately around the city is high and deeply cut by ravines, which are destitute of water in dry weather, but convey tor-

* Journal of Andrew Ellicott, late Commissioner, chapter 9, p. 4 to 288.

† Phil. Jour. Med. Phys. Sci. Vol. III, p. 1.

‡ Hist. of the Yellow Fever of Natchez in 1823.

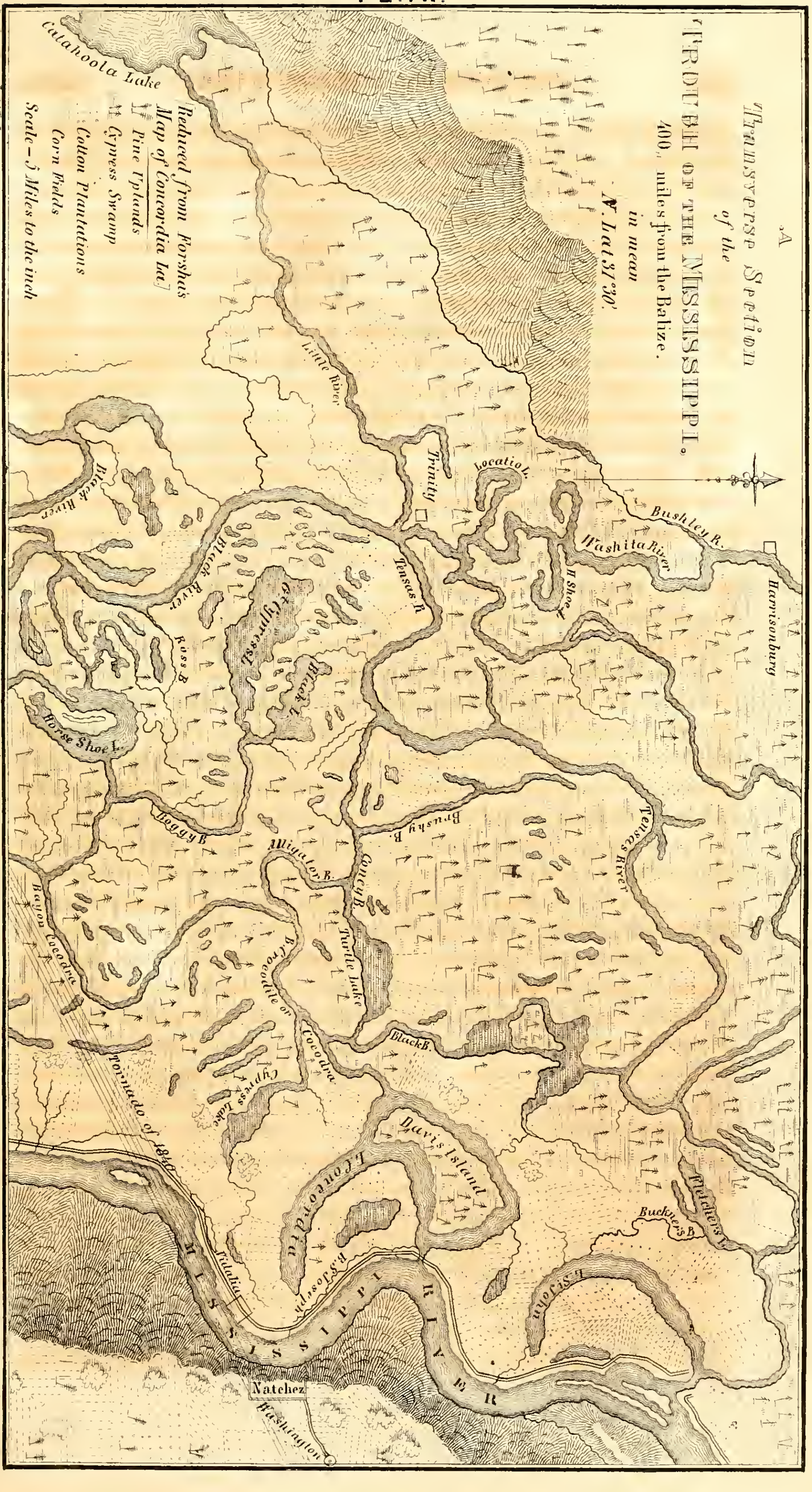
|| Amer. Med. Rec. Vol. IX. p. 1.

§ Phil. Jour. Vol. IX, p. 233.

¶ Essay on the Ep. Yel. Fev. of Natchez.

** Doctor Cartwright.

†† Doctor Merrill.



Litho by J. Wocker.

Page 124.

D. P. Whiting 7th Inf U.S.A.

rents of water during the rainy season. * To the west of the city, one of these ravines, and a depression in the bluff from a slide into the bed of the river, were for many years receptacles for dead animals and offal of all sorts; and in a gully between them and the city, there was a collection of butcheries. † The water which falls on the town plat, is chiefly collected into two bayous. One originates west of the town, the other to its south-east, and converging, they meet and flow off by a common channel to St. Catharine's Creek, a larger stream, which passes, by a south-west course, within three miles of the city, to the Mississippi river below. There are no alluvions along the bayous which drain the city plat, but they are or have been the receptacles of a great deal of filth. ‡

Natchez in the Country, as the vicinity of the city is colloquially called, presents a highly cultivated and beautiful aspect, with here and there a small pond, sometimes the work of art, designed to supply stock water for the plantations.

Natchez under the Hill, the name given to the steam and flatboat landing, is a narrow and filthy slip of alluvion, which stretches for some distance along the base of the rugged bluff, in front of the city, and is liable to inundation in high floods. The population is compact but not numerous.

VIDALIA.—Opposite to Natchez, in the Tensas Bottom, is the small and pleasant village of Vidalia, the seat of justice for the parish of Concordia in Louisiana. It consists of a single street lying immediately behind the levee. Opposite the middle of the village, the street and levee are near the river; but above they recede from it, to keep on ground sufficiently high, and in front of them there is a depression of considerable extent, which is annually overflowed. Three miles in its rear, is one extremity of the beautiful crescent lake, Concordia, which, protected by levees, is no longer filled to repletion by the river floods. Its banks are in a high state of cultivation.

WASHINGTON.—This town is six miles north-east of Natchez, and does not belong to the river bluffs; but having been visited by yellow fever, may be described in connection with Natchez. Doctor Monette§ speaks of it, in 1827, as situated on an elevated undulating plain, well drained and dry, without swamps or stagnant water of any kind in its neighborhood. In 1844, I found this description correct; and I may add, that the spot on which it stands is tertiary, and identical in composition with the site of Natchez. The country around it is rolling and highly cultivated. The village, although one of the oldest in the state of Mississippi, is small and scatteringly built. Thus there are no topographical conditions in or around it, to prevent its being adequately washed by rains, and ventilated by winds.

Diseases.—Both Natchez and Washington have been, and still are, subject to autumnal fever, which annually assumes an epidemic character, and is

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* Doctor Cartwright. † Doctor Tooley. ‡ Doctor Cartwright.

§ Western Med. and Phys. Journal (Cincinnati), Vol. I, p. 74.

oftener fatal than in the bottom on the opposite side of the river: it is, however, their liability to yellow fever, as already intimated, which gives to their topography its greatest interest.

History.—There are with Natchez and its vicinity, associations and recollections which tempt me to devote a paragraph to its annals. Here it was that the Natchez, the most civilized tribe of Indians in the Valley of the Mississippi, had their permanent residence; and on or near the place where the city is built, stood the Temple of the Sun, in which they maintained a perpetual fire — the object of their worship. On the spots where cotton is now planted, they cultivated maize, beans, pumpkins, and melons; compressed the occiputs of their children; 'paid their physicians in advance'—their medicines being 'small roots of different kinds, heads of owls, small parcels of the hair of fallow-deer, the teeth of animals, and pebble stones.'* The first white man who went among them was St. Come, a French Catholic Missionary from Canada. Soon afterward, in March, 1700, they were visited by Iberville, from the French settlement on Biloxi Bay. He was kindly received by the Great Chief — who was Master of the Temple and Brother of the Sun. Iberville, delighted with the spot, projected a town, which he named Rosalie, — the first ever planned on the banks of the Mississippi. Thus Natchez was settled in the second year after the arrival of the French on the shores of Louisiana, and eighteen years before New Orleans.† On the 28th of November, 1728, the Indians massacred all the white men of the colony save two, (whom they purposely kept as prisoners), and a few others who escaped into the woods. They likewise destroyed all the children, amounting in the whole to two hundred; and distributing the women among the tribe, reduced them to servitude.‡ In the month of February, 1730, the French, assisted by the Choctaw Indians, in retaliation, either killed or dispersed the whole tribe. Those who escaped, assembled on Red River, where they were made prisoners, and shipped to Hispaniola as slaves.|| After this extermination, the spot was repeopled with French. In 1763, Louisiana passed from France to Spain, but the east bank of the river above the thirty-first degree of latitude, including Natchez, of course, was acknowledged by France to belong to Great Britain. In the same year, Spain ceded Florida to that power. For sixteen years after these cessions, Natchez was in possession of England, during which it received many adventurers from that country, and also from Ireland, Scotland, and the colonies, now United States. In 1769, the Spaniards took possession of it; and thus a Spanish element was added to the already heterogeneous population. In 1783, Great Britain relinquished Florida to Spain, the latter still retaining possession of

* Father Le Petit: Early Jesuit Missions, part II, p. 280.
† Histoire de la Louisiane, Vol. I. Par C. Gayarré.
‡ Father Le Petit, in the Early Jesuit Missions, part II, p. 285.
|| Bancroft's History of the Col. of the U. S., Vol. III, p. 363.

Natchez. In 1795, however, she agreed by treaty to yield it to the United States, though she did not surrender it until 1798, immediately after which it began rapidly to acquire an American population, while many of the Spaniards simultaneously left it. *

Thus we see, that Natchez and its vicinity are not newly settled places, *in transitu* from a state of nature to one of cultivation; for large portions of their forest have been cut down, and the soil beneath broken up and tilled, for more than a century; thus affording a favorable opportunity for comparing their diseases with those of neighboring places, which have been but lately redeemed from the wilderness; and disclosing the influence of cultivation on the salubrity of soils of the same kind, in the same latitudes; while we learn that the population is a mixture of French, Spanish, English, Scotch, Irish, and Americans,—the last having come, at length, greatly to predominate over all the former.

III. Rodney.—This village, forty miles above Natchez, on the same side of the river, in N. Lat. 31° 30′, is built on the upper and northern extremity of a narrow bottom, which widens to the south below the town, and at the same time becomes so low as to be overflowed when the river is in flood. Much of the bottom is wide enough for a single street only, with houses on each side; but at its upper end a square is formed; and the street on its southern side, starting from the river, passes up the deep bed of a rivulet. The water of this torrent, when swollen, passes through the village square, and under many of the houses; but when not thus swollen it flows round the square to its north, and reaches the river through a deep and foul ravine immediately above the village. From February to July the water of the Mississippi stands in this chasm, which forms the boundary of the eastern and northern sides of the square, and prevents their being built upon to any considerable extent. The town was begun in the year 1823, and consists chiefly of wooden houses, many of which have their sills upon the ground and are destitute of cellars. The steamboat landing, situated opposite the lower part of the village, is considerably frequented, as Rodney is the port of a considerable region of country. Its population is about three hundred. It should be noted that although this place is ranked with the towns of the bluff, it stands upon a narrow bottom. Rodney suffers from autumnal fever in common with other towns along the Mississippi; and in 1843, it expeperienced a severe visitation of yellow fever.

Immediately above Rodney, there is a recess in the bluff, apparently from slides into the river. To the water in this recess, the early French voyagers gave the name of *Petit Golfe*. A village was begun here about the same time with Rodney, and acquired ten families; but the malignity of its autumnal fever was so great, that it was abandoned for Rodney.†

IV. Grand Gulf.—The town of Grand Gulf stands sixteen miles above

* Ellicott's Journal, p. 129.

† J. A. Watkins, MSS. *penes me.*

Rodney, and a mile below the mouth of Big Black, a navigable tributary of the Mississippi. Between this *embouchure* and the town, there is a promontory of tertiary rocks, against which the Mississippi, flowing nearly to the east, impinges, and is thrown off to the south with a very strong current. This creates an eddy or counter-current in front of the town. The space between this promontory and the mouth of Big Black river, received from the French the name of *Grand Golfe;* and hence, by a solecism, the name of the town. As the bluff stretches off to the south-east, and the river flows to the south south-west, the town is built in the angle formed by their divergence, on the head or upper end of a plain, which is above high water mark of the river, except in its greatest floods; but which, as it widens, sinks lower, so as to become inundated even within sight of the town. A cypress swamp, in fact, commences there, and continues for six or seven miles down the Mississippi, to the mouth of *Bayou Pierre.* Thus, while the immediate and ample site of the town is dry, even during great floods, and is at all times one of the most pleasant on the lower Mississippi, the bottom to its south-west is uninhabitable, by reason of the annual overflows which spread upward from the mouth of the stream just mentioned. The exhalations from this paludal tract, are wafted by the prevalent south-west winds of summer and autumn directly over the town; but within its own borders there are fewer accumulations of decomposable, organic matter, than in most the towns on the lower Mississippi. Being an importing and exporting town of for a considerable tract of country, steamboats land here almost daily. Autumnal fever is an annual epidemic at this place; but it has never suffered an invasion of yellow fever.

V. VICKSBURG — is situated on the eastern side of the Mississippi river, about fifty miles above Grand Gulf, sixty-five above Natchez, and four hundred and fifteen from New Orleans, on what were formerly called the *Walnut Hills*, in N. Lat. 32° 24′. While the Spaniards had possession of the left bank of the river, they maintained at this place a fort called Noyales. * The city dates back no further than the year 1819. Its site, the most rugged on the lower Mississippi, is a group of tertiary hills rising about three hundred and fifty feet above the level of the sea. They were deeply cut into by ravines, which have been extensively filled up by the graduation of the streets — a work which was commenced in the latter part of the year 1836, and continued through 1837, and 1838; during which the leveling necessary to a railroad depot, and a track leading into the country, was executed. The stratum cut through in these excavations, in some places to the depth of fifty feet, was a yellowish, friable, tertiary loam. The quantity removed was greater, perhaps, than in any other town on the Mississippi River. Originally both the landing place and the business houses, were on the upper part of the narrow bottom; but a better landing below, has transferred the business; and in 1844, I saw

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* Ellicott.

many deserted and decaying houses, with the high waters of the river in and around them. The river shore, also, abounded in sunken, or abandoned and moldering flatboats; the whole tract, in short, was extremely foul. Immediately above this spot, to the north, is the beginning of the overflowed bottom, through which Yazoo River makes its way into the Mississippi. On the opposite side of the latter, is the low Tensas Bottom, which has been described, and which is liable to annual submersion. The population of the city is between three and four thousand, the greater part of whom reside on the slopes or summits of the bluff. Vicksburg is liable to severe invasions of autumnal fever, and has several times been visited by yellow fever.

SECTION II.

THE YAZOO BOTTOM.

I. This bottom, lying on the east side of the Mississippi, has its lower half (or two-thirds) opposite the upper half of the Tensas Bottom. In ascending the river from Vicksburg, where it may be said to commence, we sail north north-west, for nearly half its length, and then north north-east, for the remainder. The river bank, through the whole extent of this western boundary, is so low as to be overflowed wherever levees are not erected; and there is but one village upon it — namely, Princeton, situated about one hundred miles above Vicksburg. The eastern boundary is, in its curve, not unlike the western. It commences where the tertiary bluffs begin to recede from the river, just above Vicksburg, and ends when they return to it, a short distance below Memphis. These bluffs, in the southern part tertiary, in the northern cretaceous, everywhere constitute the eastern limit of the bottom. Its widest portion lies between Marion, Carroll county, Mississippi, and Columbia, Chicot county, Arkansas, or a little higher up, and consequently near the latitude of the mouth of the Arkansas River. The diameter of the ellipse at this point cannot be less than sixty miles; and when we extend the line to the west, across the Tensas Bottom to the terminal uplands of Arkansas, we have at least eighty miles as the breadth of the interval, or high water-trough of the Mississippi, in the latitude of thirty-three degrees thirty minutes. The hydrography of this bottom is more simple than that of the two over which we have traveled. Before levees were thrown up, the Mississippi, in every high flood, poured a sheet of water over its left bank upon this bottom; and even in moderate swells, sent out several streams, which replenished its crescent lakes — Washington, Swan, Bolivar, Horse-Shoe, and Horn; from which lakes bayous flow off through the interior of the bottom. It also sends off bayous, especially from its upper part, which may be regarded as the true sources of some of its rivers. Through these bayous, the surface of the bottom generally, is still liable to inundation, while the levees along the bank of the Mississippi, and also those of the principal bayous, have redeemed many slips of land, which have been brought under cultivation. Nevertheless, the amount of population in this immense tract of interval land, is very little, compared with its area.

The great, or rather the only river of the bottom is the Yazoo, which joins the Mississippi twelve miles above Vicksburg. In the upper part of the bottom several bayous flow out of the Mississippi, the largest of which, not far below Helena, is called the Yazoo Pass. Its course is south-east across the bottom to the cretaceous bluffs, where it unites with the Tallahatchee, which has descended from the adjacent uplands. The common trunk now turns to the south, and flows near the bluffs almost to the Mississippi. On its way many tributaries from the hills flow into it. On the other side it is, near its mouth, augmented by the Sun Flower. The origin of this large tributary, is nearly as far north as that of the Yazoo; and, like the latter, it begins as a bayou of the Mississippi. In flowing on to the south it is reinforced by other bayous, directly from the great river, or indirectly from the crescent lakes. Its banks generally are overflowed during the freshets of the parent stream. It is the central stream of the bottom. Its junction with the Yazoo, is about sixty miles from the confluence of the latter with the Mississippi, near the village of Satartia.

In the month of July, 1844, I ascended the Yazoo to the city of Yazoo, formerly called Manchester, a distance of one hundred miles; the Mississippi being at the time near its extreme hight. Soon after entering the Yazoo, we found ourselves in a crescent lake; then succeeded a vista through the trees, which was from one hundred and fifty to two hundred and fifty yards in width, and afforded almost the only indication of the bed of the river, so entirely were its banks submerged. Occasionally the bluffs were to be seen through the dense forest of cotton trees, sweet gum, pecan, black willow, sycamore, and cypress, the two latter, however, in reduced proportions. Cane-brakes now and then appeared. Climbing vines, such as the *Rhus toxicodendron*, *Bignonia radicans*, and a gigantic *Smilax*, overspread the limbs of the trees and bent them to the water, where their leaves floated like the foliage of aquatic plants. On every side the inundation was perfect, and, in fact, extended, with but little dry land, to the Mississippi, distant thirty or forty miles to the west. Such is the annual condition of this bottom in May, June, or July of every year. When the flood of the Mississippi subsides, this vast, temporary, and shallow lake is drained through the Yazoo; and before the month of September, much of the surface becomes so dry as to shrink until fissures are produced in the new deposits. The physicians of Vicksburg informed me, that those who travel or work in this bottom in autumn, are subject to very malignant attacks, which they are accustomed to call the 'Yazoo swamp fever.' But Doctor Mills, of Yazoo City, who had practiced many years at Satartia on the bluffs, informed me that he found the fevers of the uplands as violent as those in the bottom.

Of the towns situated on this long line of cretaceous bluffs, most of which are new and far up the Yazoo, I can say nothing except of the

II. City of Yazoo.—Its site, in N. Lat. 32° 40′ is a gentle slope, which ascends gradually from high water mark to the summit of the bluff, in an easterly direction. Immediately across the river there are drowned lands. The city plat is dry, elevated, and beautiful; but directly exposed to the western, south-western, and north-western winds, all of which traverse the bottom. The steamboat landing is much frequented, as this is the point to which the cotton of the back country is brought for exportation, and at which supplies for the same region are landed.

Autumnal fever prevails at Yazoo, but not beyond the degree of its prevalence on the uplands in the rear of the town; and although genuine and fatal cases of yellow fever have been introduced from the towns below, the disease has never spread. During the prevalence of that fever in Vicksburg, the intercourse with Yazoo has always been unrestricted, but the latter has never suffered a visitation.

SECTION III.

THE ST. FRANCIS BOTTOM.

I. The St. Francis Bottom begins at the dividing waters between the mouths of White River and the River St. Francis, at a point not far below the town of Helena, and extends up the west side of the river, through four hundred miles of river distance, and more than three degrees of latitude, to the low hills, on which has been built the new town of Commerce, thirty miles above the mouth of the Ohio River. Its principal river is the St. Francis, which, originating on the high lands of Missouri, in the rear of Ste. Genevieve, Cape Girardeau, and Commerce, enters the bottom near its head, and joins the Mississippi not far above the town of Helena, in the state of Arkansas. It has one large tributary, the Whitewater River, which flows for a considerable distance nearly parallel to it on its left or Mississippi side. When the Mississippi is in flood, an immense discharge of water takes place over its right bank into this bottom, to be returned by the St. Francis. Most of this bottom is a forest of cotton-wood, and other trees of the middle latitudes which delight in wet and fertile soils. It also has extensive cane-brakes. It seems almost unnecessary to say that such a bottom abounds in small lakes, lagoons, bayous, and extensive swamps, representations of which may be seen in *Pl. VIII.* The most extensive tracts of marsh are found along the middle portions of the St. Francis, on Whitewater River, and between them; in many parts of which, the depth of water is too great for the growth of trees, which are replaced by aquatic grasses, and other herbaceous plants, which flourish in such localities. To the west, the bluffs which terminate this bottom, rise with considerable rapidity into the

Ozark Mountains. These bluffs are but thinly peopled, and the general surface of the bottom has a population equally sparse. Even the right bank of the Mississippi has but scattered plantations, and few or no levees. But two villages on this bank are of sufficient importance to be mentioned.

II. Helena, in latitude about 34° 20′, is remarkable for presenting us with the first land higher than the river bank, which, in ascending the Mississippi from the Balize, a distance of more than eight hundred miles, is seen on its western side. The site of the town itself is higher than the banks above and below it; while immediately back of it there are bluffs of considerable elevation. Whether they are the remains of an old diluvial deposit, or portions of the cretaceous formation, I am unable to state.

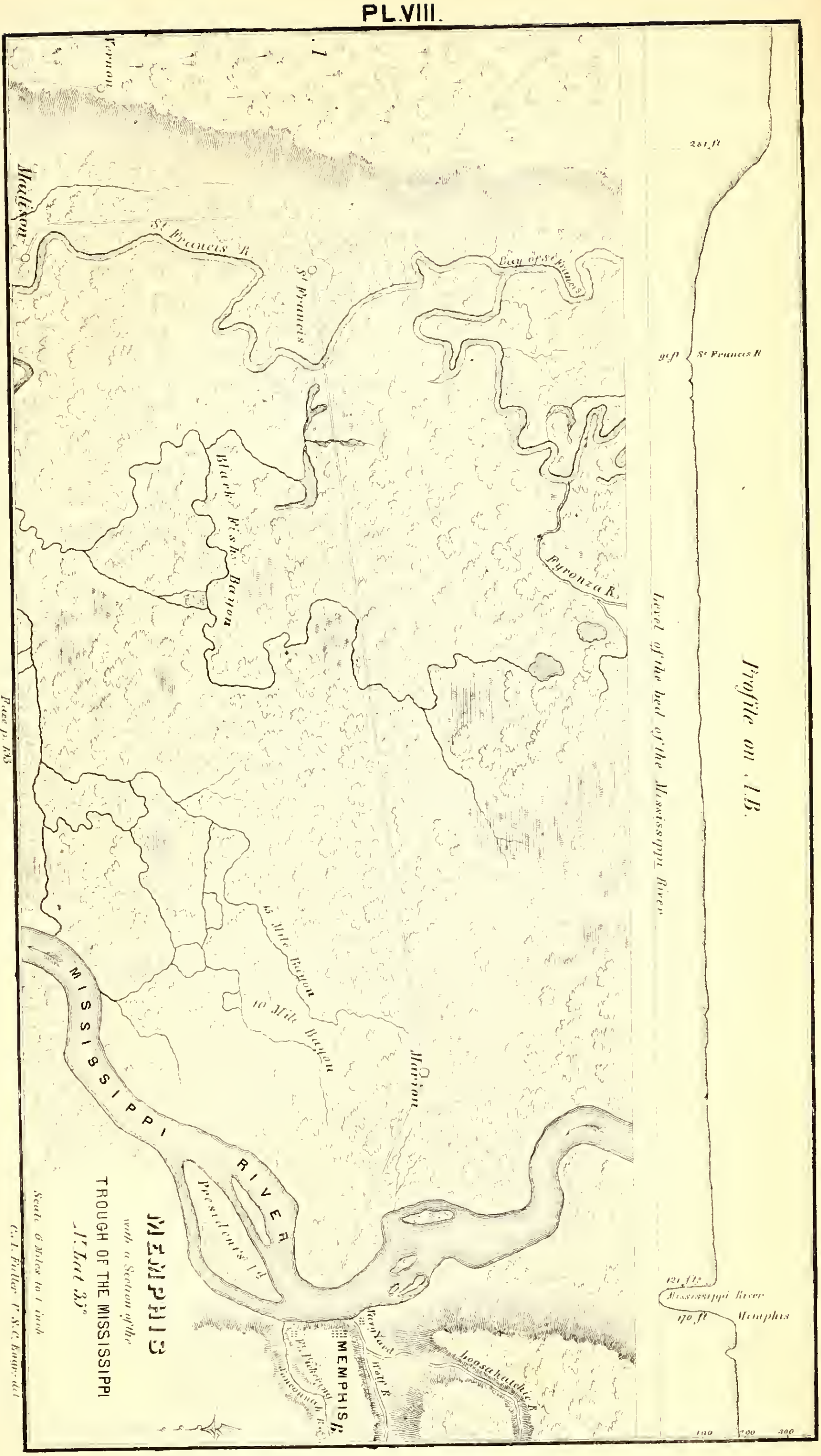
III. New Madrid.—This village was a military post under the Spanish régime. It is situated eleven hundred and fifteen miles from the Balize, and one hundred below the mouth of the Ohio, in Lat. 36° 34′ 30″ N. and Lon. 89° 27′ 15″ W. Its population is small; yet it has claims on the consideration of the medical etiologist, as standing in the focus of the only series of earthquakes, which have agitated the Interior Valley of North America, since its discovery. Beginning on the 16th of December, 1811, they continued for the next three years, during which time but few days passed in succession, without repeated vibrations at this place and its neighborhood. Those vibrations produced in the town and the surrounding region some remarkable topographical and hydrographical changes; which, with an inquiry into the influence of the whole series of earthquakes on the health of the people, may perhaps constitute the subject of a distinct Section.

The scattered inhabitants of the St. Francis Bottom are, of course, subject to autumnal fevers, which often assume a malignant character; and returns of the intermittent form of the disease, throughout the succeeding winter and spring, are in many instances so frequent as to render emigration to some other point indispensable to recovery. As in the bottoms below, the people inhabiting the banks of the Mississippi are more healthy than those living on the streams and lakes of the interior. Yellow fever has never appeared either in Helena or New Madrid.

Let us now cross the Mississippi, and examine its eastern shores. Beginning nearly opposite the lower part of the St. Francis Bottom, and ascending to the mouth of the Ohio River, we find a series of bluffs, which alternately approach to, and recede from, the Mississippi, with intervening bottom lands at the points of recession.

The four lower of these bluffs lie in West Tennessee, and have received the name of Chickasaw, from the Indian tribe which once dwelt near or upon them. The three upper, called Mills' Point, the Chalk Banks, and the Iron Banks, are in the western part of Kentucky. They all belong to the cretaceous formation; which, in its successive outcrops from the south, of course, presents at these bluffs, which lie progressively north of each other, some

PL.VIII.



MEMPHIS
with a Section of the
TROUGH OF THE MISSISSIPPI
N. Lat. 35°
Scale 6 Miles to 1 inch
C. L. Fuller U.S.C. Engr. del
Face p. 133
Vernon
Madison
St. Francis R.
St. Francis
Bay of St. Francis
Black Fish Bayou
Tyronza R.
15 Mile Bayou
10 Mile Bayou
Marion
MISSISSIPPI RIVER
Presidents Id
MEMPHIS
Navy Yard
Wolf R.
Ft. Pickering
Nonconnah R.
Loosahatchie R.
Level of the bed of the Mississippi River
Profile on A.B.
281 ft
91 ft
St. Francis R
121 ft
Mississippi River
170 ft
Memphis
100
200
300

strata not seen before. The only important town found on these bluffs I shall now describe.

IV. MEMPHIS.—The commercial metropolis of Tennessee (*Pl. VIII**), is built on the fourth or most southern Chickasaw bluff, at the distance of nine hundred miles from the Balize, in Lat. 35° 08′ N., and Lon. 90° 06′ W. Its elevation above the surface of the river at low water, is one hundred and seventy feet — over the Gulf of Mexico, four hundred. Its site is a bed of loam, belonging to the cretaceous formation. Unlike Vicksburg, Memphis occupies a gently undulating plain, on which there are some swales, but no ponds or swamps. Wells dug to the depth of from thirty to sixty feet, afford water which in most of them is very good, but in some, slightly saline and sulphurous. Immediately above the city, to the north, is the mouth of Wolf River, which has just before received the Loosahatchee, also from the north. The bottoms of this small river are wide, and subject to inundation both from its own floods and those of the Mississippi; but, except at its mouth, they are too distant from the city to exert any influence on its health. They lie, moreover, to the north-east. At, and immediately below the mouth of Wolf River, opposite the town as it was originally built, the water, at its lowest depression (which is forty-two feet from its greatest hight), was formerly deep enough for steamboats to land, and portions of the bluff sometimes slid into the river; but in 1829, an eddy began to form, and deposits have been so rapidly made, that many acres are now, like the batture at New Orleans, above ordinary high water mark, and the steamboat wharf has of necessity been moved half a mile below; causing an extension, and, in some degree, a transfer of the city in that direction. West of the town, on the opposite side of the river, is the St. Francis Bottom, of which a vertical section is given in *Pl. VIII.*

Memphis deserves the attention of the medical historian on several accounts:

1. For the last few years it has increased in population with unequaled rapidity, and promises to become a large city. Its population is exceedingly mixed, and thus presents a great variety of constitutions.

2. It has been made, by the General Government, the site of a Navy Yard, which is situated at the mouth of Wolf River.

3. The cretaceous bluffs on one side of the Mississippi, and the low alluvial bottom on the other, afford to its physicians many opportunities for studying the comparative characters, prevalence, and type of autumnal fevers on the two kinds of surface.

4. Its commerce with New Orleans is great, and steamboats make the upward voyage in four days, thus subjecting it to invasions of any and every

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* I am chiefly indebted to Doctor Shanks and Colonel Morrison of Memphis, and Doctor Borland of Arkansas, for the materials of this map, and the vertical section which it embraces.

form of disease which may prevail in that city, and can be transmitted by boats.

5. As its site is more exempt from topographical causes of fever than many other towns on the Mississippi, the question of the importation or local origin of any disease which may appear, is less complicated than elsewhere.

6. Lastly: This is the highest point up the Mississippi, and the greatest elevation above the sea, at which yellow fever has yet occurred in the Interior Valley, and it has appeared here but once; which was in the year 1828, when it prevailed as a mortal epidemic.

V. Fort Pickering.—On the bluff, two miles below Memphis, is the site of old Fort Pickering; at which, attempts have been latterly made to build a town. Much of the tract is still covered with forest, and abounds in small shallow marshes or swales. Below it to the south there is a small stream, which enters the Mississippi on the south side of President's Island, which lies in sight of Fort Pickering. I was assured that this spot is more subject to autumnal fever than Memphis, even at the mouth of Wolf River.

VI. Randolph.—This town is situated on the second Chickasaw Bluff, about seventy miles above Memphis. The bluff is higher, and more uneven on its surface, than that of Memphis. Slides are apt to occur, and its escarpment is uncommonly rugged. When visiting it, I observed the following strata, all belonging to the cretaceous formation. Beginning at the top, after a covering of soil, there is yellowish loam, becoming yellow ochre, with fragments of chert; at length growing foliaceous, and graduating into dark brown, shaly carbonaceous matter or lignite, underlaid with sand, and blue and yellow clay, mingled with shale. Slides of the bank prevented the observation from being carried lower. The surface of the bluff, although, as I have said, more uneven than that of Memphis, is less cut up by ravines than the tertiary hills of Vicksburg; and from the argillaceous character of the upper stratum, the water which falls on it is apt to be retained in small swamps, the soil of which is rich and the vegetation luxuriant. Of its autumnal fevers, I cannot speak.

Of the villages of Fulton, Mills' Point, and Columbus, on the bluffs above, I shall say nothing; but pass on to the mouth of the Ohio River. Soon after leaving Columbus, on the Iron Banks, we reach the junction of the valley of the Ohio River with that of the Mississippi. In ascending the latter to the former, for twenty miles, the bottom constantly widens, and extends with a breadth of many miles, far up the Ohio. It is heavily timbered with cotton-wood and water-maple, and is so liable to inundation as to be in a great degree uninhabitable. Geologically, it lies on the subjacent carboniferous formation, immediately north of, or beyond the cretaceous strata.

Above not less than below the Ohio, the bottom is wide and low, subject to overflows, and abounds in ponds and swamps. This, in fact, is the general character of the promontory above the junction of the Ohio and Mississippi; and from their place of union to the rocky highlands of Illinois, the distance is ten or twelve miles. In continuing up the Mississippi, the bottom gradually narrows, at the same time becoming more elevated, and at length closes in upon the Mississippi about thirty miles above the Ohio, nearly opposite the town of Commerce, or the head of the bottom on the western side of the river. A line drawn from that point on the Mississippi to a point twenty miles up the Ohio River, would have the highlands of Illinois on its north, and the bottom which has been described, on its south. The only spot within this low, paludal, and pondy tract, that merits the attention of the medical topographer, is Cairo, immediately above the junction of the two rivers.

VII. CAIRO.—The obvious value, to the steamboat navigation, of a town at the junction of the Ohio with the Mississippi, has led to expensive attempts at building one on the low cape, or peninsula, immediately above their confluence. In its natural condition, this spot was subject, every spring, especially when the two rivers were in flood at the same time, to an inundation, from one or two, to six or eight feet, according to the inequalities of the surface, and the hight of the freshets. About the year 1838, a company of capitalists undertook to throw up levees on the banks of the two rivers, and another across the peninsula, so as to inclose a sort of triangular space, sufficient for a town and its environs. This enterprise has been (imperfectly) accomplished, and there is now a small, but not very flourishing village. A part of the plan was, to throw out the water which might fall within the inclosure, or percolate its banks while the rivers were high, by means of drains to the levee, and paddle-wheels similar to those employed for that purpose in the Delta of the Mississippi. In the year 1841, when I devoted a day to the study of the medical typography of this spot, a great number of Irish and German laborers were employed on the work; and Doctor Cummings, the physician, who had spent two years among them, informed me, that they had suffered much from simple intermittent fever, into which they continued to relapse; but that malignant cases were not common. Whatever exemption from overflow the hand of labor may procure for the town plat, the drowned lands which surround it on every side, will forever subject it to autumnal fever.

The distance of Cairo from the Balize, is twelve hundred and sixteen miles; its Lat. 37° 0′ 25″ N., and Lon. 89° 2′ 30″ W. Thus it stands seven degrees immediately north of New Orleans. The surface of rivers at low water opposite the town is between two hundred and ninety, and three hundred feet above the Gulf—that of the town plat is about forty more.*

* Colonel Long (*First Expedit.*) had fixed, by estimation, on three hundred feet, for the low water level of the Mississippi and Ohio at their junction; but Mr. Nicollet (*Hydr. Basin*), from barometical observations, afterwards placed it at three hundred and twenty-four feet. Two lines of leveling from Lake Erie to the Ohio River (*Indiana Reports*) have, however, coincided in establishing three hundred and eleven feet, as its low water surface of that river opposite Evansville, two hundred miles from its mouth. Relying, as we ought, on these levelings, by which public works are constructed, both Mr. Nicollet and Colonel Long have placed the mouth of the Ohio at too great an elevation. It cannot, in fact, exceed two hundred and ninety feet.

SECTION IV.

GENERAL REMARKS ON THE PRECEDING BOTTOMS.

About thirty miles above Cairo, the St. Francis Bottom, as we have seen, is terminated by approximating rocky highlands. Beyond this point there is no other bottom at all comparable in width with those below. It may, in fact, be said that we have reached the vertex of the ancient estuary; whence it will be profitable to look back, for a moment, on the surface over which we have ascended. Three sections of this surface are represented in *Pls. V, VII, VIII,* and another (which illustrates the bottom above) may be found in *Pl. IX.* By comparing these diagrams, it will be perceived that the same hydrographical system prevails in all, but becomes less and less complicated as we ascend the river.

The area of this alluvial region, the most extensive in America, may be estimated, from the mouth of Red River, in latitude thirty-one degrees, to the upper extremity of the St. Francis Bottom, in latitude thirty-seven degrees and a quarter, at about twenty thousand square miles. The distance on a straight line is about four hundred miles — by the river, upward of nine hundred. In running the whole distance, the river only once (at Helena) comes in sight of bluffs on the western side, but keeps near them on the east. They consist of two series; the *first* extending from the Iron Banks below the Ohio River, to a point below Memphis— the *second,* from Vicksburg to a point below Baton Rouge. The upper are composed of cretaceous, the lower of tertiary deposits. Between these ranges of highlands, the river makes a western *detour,* and gives us the Yazoo Bottom on its eastern side. Why the stream, from the mouth of the Ohio to Baton Rouge, inclines so strongly to the eastern bluffs, cannot perhaps be told.

The redemption from a watery dominion of this great alluvial region, in which the states of Louisiana, Arkansas, Mississippi, Tennessee, Missouri, Kentucky, and Illinois participate, offers to the engineer and the physician, problems in which the public have a deep and varied interest. Without attempting their solution, I may venture the suggestion, that embankments alone will not answer, but that side channels, to relieve the main trunk, will be indispensable. The uppermost of these might be carried, from some point above the mouth of the Ohio, into Whitewater River, a branch of the St. Francis; which river, thus augmented, would return the escaped water into the main trunk opposite the upper end of the Yazoo Bottom. Through that bottom one or more sluices might be made into the Yazoo River, which joins the Mississippi above Vicksburg opposite the Tensas Bottom. To obviate the effects of this restoration, other sluices might be made below the Arkansas, into the bayous that ultimately terminate in the Washita, which empties into Red River. All the escaped water would thus, it is true, again be brought back into the main bed; but relief might be given by widening and deepening the bayous Atchafalaya, Plaquemine, Manchac, and La

Fourche, which ultimately communicate with the Gulf.* Without thus providing lateral and parallel channels, no system of embankments along the Mississippi, could, by possibility, be made strong and high enough to protect the bottoms from inundation. Of course the banks of the auxiliary streams and sluices would require levees. In reflecting on the possibility of thus reclaiming this large tract, we must recollect that the fall from its upper extremity to the Gulf is more than three hundred feet; and, of course, if artificial channels of adequate capacity should be provided, no overflows would occur. It would aid in this work, however, in several places where the river makes *detours* and returns almost to the point of departure, to cut through the isthmus thus formed, whereby the length of the stream would be abridged, and the velocity of the current correspondingly increased.

How long a period will elapse, before the population of the Interior Valley will be dense enough, to lead to the execution of such an extended system of protection from the floods of the Mississippi, and to the complete reclamation of the bottoms, cannot be predicted; but whenever it shall be done, a signal increase of summer and autumnal salubrity must be the consequence; and no portion of the Great Valley will then present more fertile soils, and softer climates, or, taking the year throughout, more healthy residences, than the bottoms from the mouth of the Ohio to that of Red River.

SECTION V.

AMERICAN BOTTOM.

I. Above the St. Francis Bottom, there are no large and continuous interval lands, until we approach the mouth of the Kaskaskia River, immediately above the village of Chester, which stands on carboniferous limestone, in the state of Illinois, about one hundred miles above Cairo. At this point we enter the American Bottom (*Pl. IX*). As this bottom ascends it gradually widens, until it attains, opposite St. Louis, the width of seven or eight miles. Its average width is about five miles. Its termination is at the bluffs of the town of Alton, twenty miles above St. Louis, and nearly opposite the mouth of Missouri River; making its length nearly one hundred miles. The immediate bank of the river is heavily wooded, but in the rear of this belt there is a great deal of prairie, abounding in sloughs, ponds, lakes, and bayous, which are replenished in spring, and partly dry up in summer and autumn. The inundation of this bottom is not, however, so deep and general as that of those below.

In the American Bottom there are, or were, three or four French villages: Fort Chartres, Kaskaskia, Cahokia, and Prairie du Rocher; two of which

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* Darby's Louisiana.

are among the oldest settlements in the Valley of the Mississippi. It does not appear that their inhabitants are, or have been, much affected with autumnal fever; but many of them are rather dwarfish and shriveled.* The Americans, who have settled in this locality, are sickly in summer and autumn. Doctor Farrer, of St. Louis, informed me, that in former years, he could distinguish, by their sallow complexion and languid aspect, the people of the American Bottom from those of the country back of the city.

On the Illinois bluffs, east of the bottom, there is no spot worthy of notice. These bluffs consist of limestone, containing beds of coal. Their elevation is from six to seven hundred feet above the sea. A considerable portion of them is appropriated to the culture of the *Ricinus communis;* and the manufacture of castor oil is prosecuted there and in St. Louis, to a greater extent than in any other part of the United States. On the Missouri side, we may pass by the old French town of Ste. Genevieve, with several newer American villages, all seated on, or at the foot of, the high bluffs of carboniferous limestone, which rise in some places like mural precipices, to the hight of eight hundred feet above the sea, and stop at

II. JEFFERSON BARRACKS.—The bluff is here more depressed and of gentler ascent from the river. This post is in Lat. 38° 28′ N. and Lon. 90° 08′ W. The carboniferous limestone, which abounds in coal, like the bluffs on the opposite side of the river, is considerably fractured, and portions of it are changed from their horizontal position, apparently by an upheaving force. Thus the surface is uneven, and the rents and apertures of the strata favor the drainage of the surface. A great object of the Government in establishing this post was, to have a healthy asylum for troops broken down by service in the hotter climates; to which end it would be well adapted, but for the contiguity of the American Bottom on the opposite side of the river. According to Doctor De Camp, whenever, in August or September, the wind blows over the barracks from that bottom for a few days, intermittents break out among the troops; while the people who live a mile or two from the river, in the woods, escape. The returns show a ratio of thirty-four per cent. per annum for intermittents, and of sixteen for remittents.†

From the barracks to St. Louis the distance is twelve miles. The bluffs, consisting of the same limestone, continue low, and in most places rise gently from the river. Between the two places, stands the ancient French village of Carondelet, bearing to the American Bottom a relation similar to that of Jefferson Barracks; but its native inhabitants do not seem to have suffered much from autumnal fever. Several miles higher up is the United States Arsenal, built on a gentle and rocky slope.

III. ST. LOUIS.—While New Orleans is the metropolis of the whole basin of the Mississippi, St. Louis is the emporium of the northern half of that basin. Destined to be forever the most important city on the banks of the Missis-

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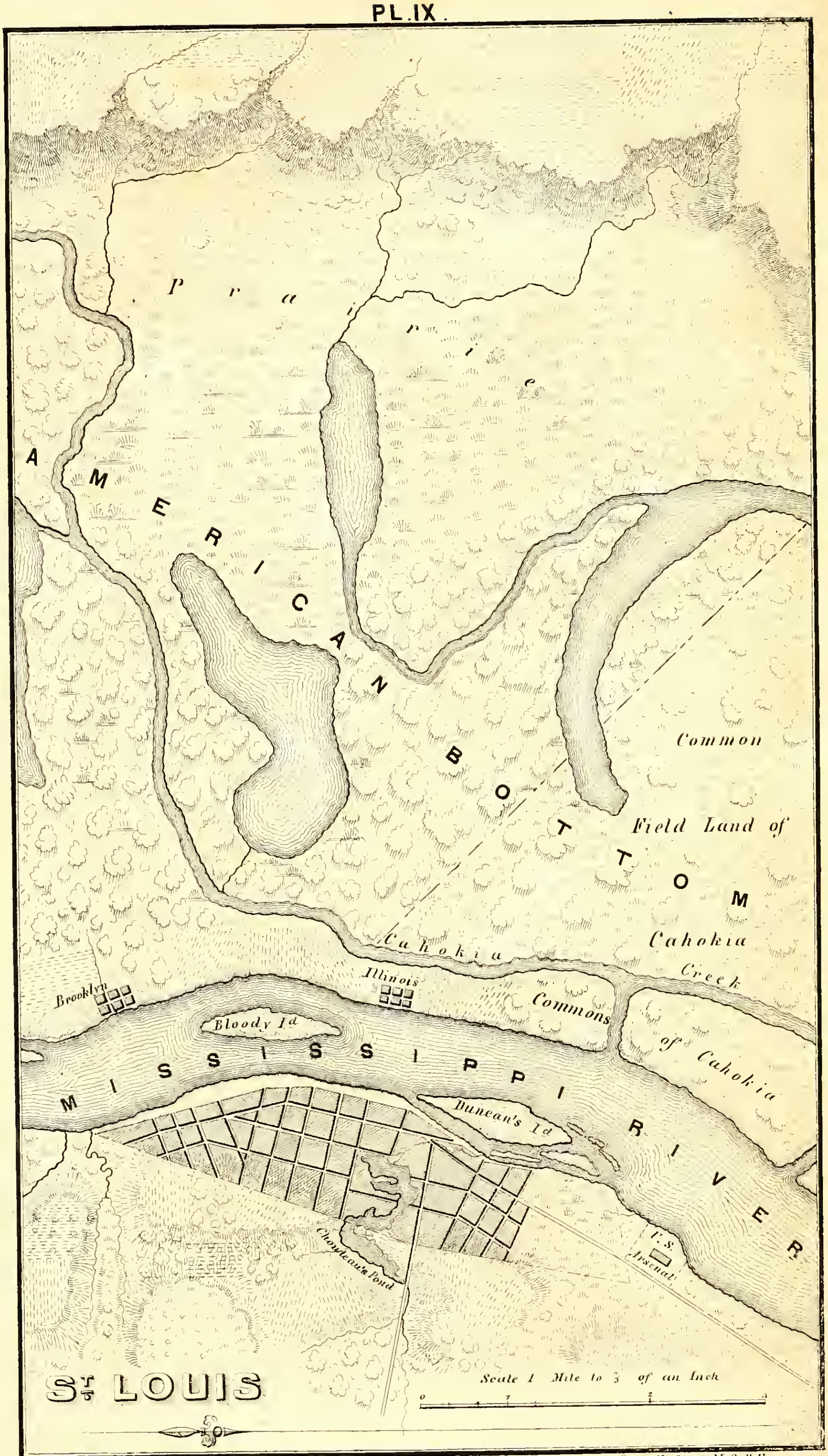
* Peck's Gazetteer of Illinois.

† Med. Stat. U. S. A.

PL. IX.



Lith. A. Weck

Face 139.

C.A. Fuller U.S.C.Engr.

sippi, above New Orleans, it may justly claim the attention of the medical etiologist.

Its distance from the Balize is thirteen hundred and ninety miles — from New Orleans twelve hundred and eighty-six. Its Lat. is 38° 37′ 28″ N.; its Lon. 90° 15′ 39″ W. Thus it stands 8° 40′ 5″ N. and 16′ 35″ W. of that city. The general course of the Mississippi is well shown by these numbers. In flowing twelve hundred and eighty-six miles, and traversing nearly nine degrees of latitude, its longitudes at those cities, vary less than three quarters of a degree. According to Nicollet,* the elevation of the river, at low water, opposite St. Louis, is three hundred and eighty-two feet above the Gulf, or three hundred and seventy-two above the surface at New Orleans. If this be correct, the fall in the Mississippi from the upper to the lower city, is three inches and forty-seven hundredths a mile; or eight inches and six tenths for each minute of latitude.

The topography of St Louis and its environs, is so intelligibly represented in *Pl. IX*, that a protracted description is not necessary. Its contiguity to the American Bottom, shows that it may be injuriously affected by the exhalations of that tract, when easterly winds prevail. The immediate bank on that side—the bed of the river—Bloody Island opposite the upper part of the city — and Duncan's Island in front of the lower part, are little else than deposits of sand with embedded drift-wood. The former island lies near the middle of the river; but the latter is separated from the St. Louis shore by a narrow and shallow channel. This island, like others of the Mississippi, is extending up stream by deposits on its head, and has come to interfere with the harbor. Both islands are subject to inundation, but their limited areas and sandy surfaces, prevent the formation of ponds or marshes. The upper island is covered with young cotton-trees.

The city is built in a gentle bend of the Mississippi, which flows nearly from north to south. Its site is a bed of carboniferous limestone, covered with deposits of loam; which, though generally deep, are in many places so thin that the foundations of the houses rest on the solid rock. Above the city the rocks appear in low bluffs. Those portions of the city which lie farthest down the river are built on low ground, which in high floods are subject to inundation. A bayou from the river on the west side of Duncan's Island passes through this tract, and is skirted by narrow marshes; it is also traversed by a brook from the adjoining low bluffs. In the south-western part of the city lies Chouteau's Pond — a serpentine basin of water, supplied by a small stream, and having an outlet which passes across the southern portion of the plat, in a broad ravine, to the river on the west of Duncan's Island; thus adding to the paludal character of that part of the city. The water of the pond is deep, and its margins well defined; but with the increase of population, it is becoming a receptacle for filth.

* Hydrograph. Basin.

In front of the city the beach or quay is narrow and paved. In the great flood of 1844, it was deeply inundated, and the first range of houses had their lower floors covered to the depth of several feet. From these houses the bank rises in a gentle and regular manner to the elevation of eighty feet above low water-mark, making it four hundred and sixty-two feet above the level of the sea.* In advancing into the country, in any western direction, from south round to north, we either continue on this, or gradually rise to a higher level. The rocks beneath are calcareous, with beds of coal. The general aspect of the surface is that of levelness, and some small portions incline to be swampy; but, in general, the drainage is perfect, by means of the inequalities, the fissures, and the apertures of the subjacent rock. The soil is rich and argillaceous rather than sandy, and where not cultivated is covered with a thin growth of oak and hickory trees, with copses of hazel bushes. The rapid growth of the city has led, in latter years, to a great deal of leveling, and consequently to the exposure of much new surface to the action of the elements.

The settlement of St. Louis was begun on the 15th of February, 1764; forty-six years after that of New Orleans; and twenty-four years before that of Cincinnati. Its founder was Pierre Ligueste Laclede, assisted by two young creoles, Auguste and Pierre Chouteau, all of New Orleans. A considerable French population soon collected there, chiefly from Fort Chartres, Kaskaskia, Cahokia, Vincennes, and other French villages east of the Mississippi; a region which, in 1763, had been ceded by France to Great Britain. In 1768, the town, with Louisiana generally, passed into the hands of Spain, having been previously ceded to her by France. But the immigration of Spaniards was inconsiderable, and although the town continued under Spanish rule up to 1803, the people were chiefly French. In that year, Louisiana was restored to France, and transferred, *instanter*, to the United States; whence it began to receive a new element of population. Within the last fifteen years, this population has increased at a remarkable ratio; and for five or six years past, there has been a great influx from Germany. Thus the present population consists of three kinds, the original French, the Anglo-American, and the German.

From the earliest date of its settlement, St. Louis has been an emporium of the fur trade of the west and north; and the head quarters of the *voyageurs* or *engagees* to be hereafter described. For the last twenty years, its steamboat trade has been immense; and, of course, its port has abounded in watermen of a different class. Its manufacturing population has not yet become numerous.

The inhabitants are supplied with river-water, which is received through a hydrant system, after depositing its silt in a reservoir. Situated only eighteen miles below the junction of the Missouri with the Mississippi, and on the side through which the former enters, the water pumped up for the

* Nicollet.

supply of the town is entirely from that river, which is well known to be the most turbid in the Great Interior Valley.* The deposit from a single gallon, which I took up when the river was above its mean hight, weighed one hundred and eighty grains. The greater part of this foreign matter is, however, thrown down before it leaves the reservoir.

Compared with the American Bottom on the opposite side of the river, St. Louis is but little affected with autumnal fever; nor is it as liable as the country in its rear. The parts which suffer most are the southern suburbs, and the new extensions to the west. As in our other cities, the central portions are most exempt.

SECTION VI.

UPPER MISSISSIPPI.

I. General Description.—From St. Louis to the mouth of the Missouri and the head of the American Bottom, which is found nearly opposite, the distance is eighteen miles. Here, what may be called the Lower Mississippi terminates, and the Upper commences. At this point it may be seen that the turbid waters which continue to the Balize, and even roil the margins of the Gulf of Mexico, flow out of the Missouri; those of the Mississippi, above the junction, being transparent, and of a delicate, brownish tint. The surface of the river at this junction, when the water is lowest, is, according to Nicollet, three hundred and eighty-eight feet above the level of the Gulf. The broad alluvial bottoms are now at an end, and the carboniferous limestone bluffs are in sight at the same time, on both sides of the river. Boiling eddies, and crumbling banks, and bars, and islands composed of sand and trunks of trees bearing young groves of cotton-wood, (destined soon to be swept away), are no longer seen; but, as we ascend, broad expansions of the river, with permanent islands, overshadowed down to the water's edge, with various trees, shrubs, and herbaceous plants, meet the eye. Many of them, however, are liable to submersion during the spring freshets. For some distance up, the bottom lands are low, and, like some of the islands, are subject to inundation. At length, bowlders of various sizes, and terraces of diluvial sand, gravel, and pebbles, begin to show themselves in the rear of the alluvial bottoms. As we advance, the distance between the opposing hills gets less, the bottoms become more elevated and habitable, and the gravel banks increase in number and hight. The hills, which for some distance were comparatively low, begin now to rise into greater altitude. Part of them are wooded, and part display a surface of prairie. Where a tributary enters, the valley

* From the mouth of the Missouri to a distance of, perhaps, three miles below St. Louis, the waters of that river do not mingle, to any noticeable extent, with those of the Mississippi; but are clearly distinguishable by their color, and are found, at all points, on the western side of the river.

is generally wider, and the bottoms above and below its mouth, are so depressed as be to overflowed. In some places there are gentle rapids for many miles, the river being expanded into shoal water, flowing over a rocky bed. Such is the Upper Mississippi, as I have seen it, to the mouth of Fever River, three hundred and eighty miles above the mouth of the Missouri, four hundred above St. Louis, and seventeen hundred from the junction of the Mississippi with the Gulf. The latitude of Fever River is about forty-two degrees thirty minutes north, or thirteen degrees thirty minutes north of the Balize. From this point to the Falls of St. Anthony, five hundred miles higher, a few villages and two military posts embrace nearly all the population; and as the medical topographer is interested in none but peopled countries, I shall not attempt a further delineation, but, returning to the *embouchure* of the Missouri, give some account of a few localities.

II. Junction of the Rivers.—About twenty-five miles above their junction, the Mississippi and Missouri Rivers approach within nine miles of each other: whence they continue nearly parallel, in an eastern direction, until at length the Mississippi bends to the south, and receives the Missouri as a tributary. Along the Mississippi, the peninsular cape, above the junction, is, through its whole length, so low as to be subject to inundation. On the Missouri it has the same character for about twenty miles, up to the Mammelles, which are high knobs, apparently belonging to a tertiary formation.

The Bottom.—Most of the peninsular bottom is prairie, on the lower portions of which the river floods leave swamps, bayous, and lagoons. There are portions, however, which consist of diluvium, and are so elevated that even the great flood of 1844 did not overflow them. Its population is sparse, and subject to intermittent and remittent fevers: which, as Doctor Twyman, and Doctor Thompson, and Doctor McCullough, of St. Charles, informed me, are sometimes of a malignant character.

III. St. Charles.—Three miles above the Mammelles is the old French village of St. Charles, now (in population as well as jurisdiction) an American town. It stands on carboniferous limestone rocks, which rise gradually from the Missouri to the hight of eighty or one hundred feet. The country around is dry, and of the same elevation. On the opposite or south side of the river there is a heavily timbered, rich bottom, two miles wide, which is liable to be inundated. Nearly surrounded by the localities which have been described, the people of St. Charles, although its site is of a healthy character, are by no means exempt from autumnal fevers. We must now cross the Mississippi to the

IV. Towns of Alton—Lower and Upper.—Not having visited these towns, nor met with a description of their medical topography, I would not mention them, but from the fact that, situated but a few miles above the mouth of the Missouri, it is predicted that they will grow into great commercial importance. Lower Alton is built on a rocky foundation between the river and the bluffs: Upper Alton is on the bluffs, two miles from the river. The country around is said to be free from marshes; but the lower town is exposed to the exhalations from the peninsular bottom, on the opposite or western side of the Mississippi.* Of the degree in which they are infested with autumnal fever, compared with other towns on the Mississippi, I am not informed.

V. Quincy.—This town stands on the left bank of the river in the state of Illinois, a little below the fortieth degree of latitude. From Doctor Daniel Stahl,† I learn that its site is a diluvial terrace, eighty or one hundred feet above the river. Its composition is such that it greedily absorbs the rains which fall upon it, and favors the production of dust much more than mud. Well-water, with its usual saline impregnations, is in general use. The surface of the ground in the vicinity of the town, is elevated, rolling, and dry. An alluvial creek enters the Mississippi twelve miles above the town, and another nine miles below; but neither approaches it so near as to exert upon its inhabitants any injurious influence. In the opposite direction the condition is less favorable. Near the town, there are low, wooded islands, which are overflowed in spring, and left with ponds to be evaporated in summer and autumn: and on the further side of the river, in the state of Missouri, there is a tract of bottom, subject to annual inundation, with its consequent ponds and marshes. The surface, generally, is prairie; but on the river bank there is a grove of forest trees. These islands and the bottom lie to the west of Quincy, and the prevalent winds of summer and autumn pass over them; but the intervening trees and river may be supposed to exert a protecting influence.

Doctor Stahl has favored me with a history of the diseases in this town for the year 1842, from which it appears that no case of autumnal fever occurred in his practice until the latter part of September, and no new case appeared after a month from that time; from which we may infer that the disease is not very formidable at this place.

Quincy is a young town which has grown rapidly to a respectable size. The population is largely from New England and New York, with a few from Kentucky and other states. The European immigrants are principally German — a large element — with a considerable number from Ireland and England. Thus, like the other towns along the Mississippi, this embraces a variety of national temperaments and habits.

VI. Burlington.—Doctor John F. Henry has favored me with the principal materials of the following notice of this locality. The city of Burlington, Iowa, stands on the west bank of the Mississippi river, two hundred and fifty miles above St. Louis, and a mile below the mouth of Flint River; the latitude of which, according to Nicollet, is 40° 52′ 56″ N., and the elevation of the surface of the river, at low water, four hundred and eighty-six feet

* Peck's Gazetteer of Illinois.

† MS. *penes me.*

above the Gulf. The mouth of Flint River and the city are separated by bluffs, which here approach to the very shores of the Mississippi. Immediately below them, a slip of bottom land, about two hundred yards in width, begins and stretches for a mile down the river; having for its back ground a range of bluffs, which rise to the estimated hight of about one hundred feet. A stream originating in the rear makes its way through these bluffs, and traverses the narrow bottom, near its middle, to join the Mississippi. Its valley is about three hundred yards wide, and considerable portions are liable to inundation from its own waters. The river bottom below the mouth of this torrent is likewise subject to submersion from freshets of the Mississippi. In addition, many springs burst out near the base of the hills, and water the bottom. Such is the site of the city, which is built on the narrow belt, above and below the brook by which it is traversed, and on the hills in its rear. From the mouth of Flint River, an extensive bottom stretches, for many miles, up to the mouth of Iowa River. Its average width is four or five miles; and, like the American Bottom, opposite St. Louis, it is liable to partial inundations, which, together with the descent of streams from the bluffs, gives it a surface abounding in sloughs, ponds, and bayous. The position of this bottom is directly north of the city. To the south, or below the city, the bluffs close in upon the river, and continue near it for four or five miles, when a bottom commences. On the eastern or Illinois side of the Mississippi, opposite Burlington, there is a bottom several miles wide which extends up and down the river, and closely resembles that lying between Flint River and the Iowa. In extreme floods of the Mississippi, the whole of this Illinois bottom is submerged. On the evenings of hot days, in the latter part of summer and in early autumn, the exhalations of this bottom are often extremely offensive to the smell. Finally, in the river above the city, there is a series of low, wooded islands.

Burlington is situated near the western margin of the Illinois Coal Basin, and is abundantly supplied with spring-water, having the usual mineral impregnations. As on the sites of other young and flourishing towns, there is in Burlington a great deal of excavation and leveling of the surface, which often occasions temporary ponds or sloughs.

On the subject of autumnal fever, Doctor Henry remarks — "The bottom lands above and below the city, and also on the opposite side of the river, are the chosen seats of intermittents, by which the people every year are more or less prostrated; nor do the immigrants seem to become acclimated." Remittents also occur. It is an undecided point, whether the people of the city who live on the bottom are more subject to fever than those on the bluff. The country population in the rear of the city are not exempt from the fever, especially where there is an extensive breaking up of new lands, as the beginning of cultivation. Near the river there is woodland, but prairies soon succeed, and spread off indefinitely to the west.

This description of the Burlington locality, may serve for a large proportion of the Upper Mississippi.

VII. Rock Island Locality.—Rock Island was formerly the site of Fort Armstrong. On the western side of the Mississippi, opposite the island, in the state of Iowa, stands the town of Davenport. On the eastern, in the state of Illinois, rather below the island, stands the town of Stephenson. Three miles below is the mouth of Rock River. The whole of these properly belong to one locality, which I can describe in the most general terms only.

The island, according to Nicollet, is seventeen hundred and twenty-two miles from the Balize, and three hundred and thirty-two above St. Louis, in N. Lat. 41° 31′ 50″. The elevation of the surface of the river at low water is five hundred and twenty-eight feet above the Gulf.* The surface of the island is about twenty feet higher. Fort Armstrong, now abandoned, stood on the southern extremity of this island. Davenport is elevated above high water-mark; but to its south, at the distance of two or three miles, there is a tract of low bottom. Stephenson is on a plain less elevated than the site of Davenport, but above ordinary high water-mark. In the direction of the mouth of Rock River, this bottom sinks so low as to be subject to inundation. Thus, to the south of both towns, as well as of the intervening island, there are tracts of insalubrious surface.

Of the prevalence of autumnal fever in Davenport and Stephenson, I cannot speak. Troops were stationed at Fort Armstrong for seven years, during which the ratio of intermittents was seventeen per cent., and of remittents ten per cent.†

This locality, like St. Louis, is within the Illinois Coal Basin. It lies at the foot of the Upper Rapids, the fall on which, according to Nicollet, is twenty six feet in fifteen miles.

VIII. Galena.—The latitude of this town is 42° 24′ N.,—its distance above St. Louis about four hundred miles. It stands on either side, but chiefly the north-west, of Fever River, six miles from its junction with the Mississippi, in the state of Illinois. From a point one or two miles above the town, down to its mouth, this river is a mere canal, without perceptible current, except when very high, or when the Mississippi is very low. The site of the town is a ravine or chasm, with high bluffs, composed of upper Silurian limestone. Narrow as the bottom is, a part is liable to inundation during freshets of the Mississippi; but the inhabitants, for the purpose of acquiring an ampler town plat, are engaged in raising it with the *debris* of the adjoining bluffs. These bluffs afford copious permanent springs of hard water. From the town down to the Mississippi, Fever River meanders through a narrow defile; but at its mouth there is an alluvial bottom of

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* Hydrograph. Basin.

† Med. Stat., U. S. A.

limited extent, liable to inundation, and a low, long island in the Mississippi, which turns the main stream of that river to the opposite or western side. The few inhabitants who have resided at the mouth of Fever River, have been very constantly affected with fever in autumn; but those of the town above are not particularly liable; and the ominous name which the river has acquired (from a corruption of *fève*, bean), is by no means appropriate. The French were the first inhabitants of this locality. At present, its population is exceedingly mixed, and embraces not a few from England, attracted thither by the lead mines.

IX. PRAIRIE DU CHIEN — FORT CRAWFORD.— Immediately above the junction of Wisconsin River with the Mississippi, lies *Prairie du Chien*, the general level of which may be seventy feet above low water. It extends up the latter river eight or ten miles, and is about two in width; being limited by a range of hills rising more than three hundred feet above it. The western margin of this plain is liable to inundation in high floods of the Mississippi; and when they subside, there remains, in summer and autumn, a long, narrow slip of marsh, abounding in decaying organic matter. Adjacent to the mouth of the Wisconsin, this slip is much wider.* On the opposite side of the river, the high bluffs press close upon it. The cliffs of both sides present on their summits the lower strata of the blue Silurian limestone of Cincinnati, beneath which are saccharoidal sandstone and magnesian limestone down to the water's edge.† Its distance above St. Louis is about five hundred miles; its Lat. 43° 3′ 6″ N., Lon. 91° 9′ 20″ W. The elevation of the Mississippi at low water is six hundred and forty-two feet, of the adjoining hills one thousand feet,‡ above the Gulf.

This prairie enjoys the distinction of having been trodden by civilized feet before any other portion of the banks of the Upper Mississippi; as it was here that the Jesuit Father Marquette, and M. Joliet, in descending the Wisconsin River, reached the Mississippi, on the 17th of June, 1673.‖ A French fur-trading village was in due time established here, which flourished awhile and then declined. Latterly, it has attracted the attention of immigrants into Wisconsin, and promises to become a town of considerable size.

Fort Crawford stands on the same plain with the village, but two miles nearer the mouth of the Wisconsin; and consequently is more exposed to insalubrious exhalations. The ratio of intermittents is twenty-eight per cent.; that of remittents, four.§

X. FORT SNELLING.— This military post (*Pl. I*), the highest up the Mississippi, stands on the point of land immediately above the junction of

* Med. Stat., U. S. A.

† Owen: Geological Rep.

‡ Nicollet: Hydrog. Basin.

‖ Bancroft: Hist. Col. U. S., Vol. III.

§ Med. Stat., U. S. A.

the St. Peter's with that river. According to Nicollet,* the low water-surface of the rivers at this junction, is seven hundred and forty-four feet above the Gulf; the average elevation of the plain which the fort occupies, eight hundred and fifty; and the hight of a neighboring hill, called the Pilot Knob, one thousand and six. The latitude of this post is 44° 52′ 46″ N.— the longitude 93° 4′ 54″ W. Its distance from Prairie du Chien is two hundred and forty miles, from St. Louis seven hundred and forty-eight, from New Orleans two thousand and eighty-eight, and from the Balize two thousand one hundred and ninety-two.† The descent of the river, following its meanders to the Gulf, is four inches a mile: on a straight line, nine and a third inches for every minute of latitude.

The Mississippi flows past Fort Snelling with a rapid current; but the estuary of the St. Peter's is sluggish, and the discharge of its waters into the Mississippi is impeded by an island, with a slough on the side which the St. Peter's approaches, through a low prairie bottom a mile in width. ‡

The waters of the Mississippi are transparent, but those of the St. Peter's turbid and of a whitish hue, and hence its Indian name, Minisotah, which expresses turbidness. || To the north of the post, on the uplands, there are small lakes. § According to the army returns for ten successive years, during which the average number of troops stationed at this post was one hundred and fifty, the ratio of intermittent fever was but a fraction over four per cent. per annum, and that of remittent, two. ¶ This is a much more limited prevalence than would result from the same topographical conditions in the south, and shows, very conclusively, the influence of climate.

Having arrived at the highest settlement on the Mississippi River, it may be instructive to recapitulate, in a tabular form, the relative prevalence of autumnal fever at the military posts which stand upon its banks.

Posts.	N. Lat.	Distance from the Balize.	Elevation above the Gulf of Mexico.	Ratio per cent. per annum of Intermittents.	Ratio per cent. per annum of Remittents.
Fort Jackson,	29° 29′	30 m.	4 ft.	114	15
Baton Rouge,	30° 36′	145	90	51	30
Jefferson Barracks,	38° 28′	1,378	460	34	16
Fort Armstrong,	41° 32′	1,722	550	17	10
Fort Crawford,	43° 03′	1,932	720	28	4
Fort Snelling,	44° 52′	2,192	850	4	2

It will be seen from this table, that, in advancing north through fifteen degrees of latitude, and eight hundred and fifty feet of elevation, there is, with the exception of Fort Crawford (unfavorably situated near the mouth of the Wisconsin), a regular decrease of intermittent fever, from one hundred

* Hydrograph. Basin.

† Hydrograph. Basin.

‡ Featherstonhaugh's Geol. Rep.

|| Long's Expedition, Vol. I.

§ Ibid.

¶ Med. Stat. U. S. A.

and fourteen per cent. down to four; and from Baton Rouge, the second post, a regular decrease of remittent fever from thirty to two per cent.

XI. Falls of St. Anthony.—For nearly thirty miles above Fort Snelling there is a continued chain of rapids, in the midst of which are the Falls of St. Anthony, the only cascade of the Mississippi River. Its distance from the fort is eight or nine miles.

On approaching the edge of the rock from which the water is to fall sixteen feet, the river spreads out to the breadth of more than six hundred yards; but contracts below to one-third of that width, and dashes forward over masses of rock, detached from the bluffs which form the chasm. The river cascade is thus described by Mr. Keating—

"The irregular outline of the fall, by dividing its breadth, gives it a more impressive character. An island, stretching in the river both above and below the fall, separates it into two unequal parts, the eastern being two hundred and thirty yards wide, and the western three hundred and ten. The island itself is about one hundred yards wide. From the nature of the rock, which breaks into angular and apparently rhomboidal fragments of a huge size, this fall is subdivided into small cascades, which adhere to each other, so as to form a sheet of water, unrent, but composed of an alternation of retiring and salient angles, and presenting a great variety of shapes and shades; each of these forms in itself a perfect cascade, but when taken together in one comprehensive view, they assume a beauty of which we could have scarcely deemed them susceptible. We have seen many falls, but few which present a wilder and more picturesque aspect than those of St. Anthony. The vegetation which grows around them is of a corresponding character. The thick growth upon the island imparts to it a gloomy aspect, contrasting pleasingly with the bright surface of the watery sheet which reflects the sun in many differently colored hues."

"The country about the fort contains several other water falls, which are represented as worthy of being seen. One of them, which is but two miles and a half from the garrison, and on the road to the St. Anthony's, is very interesting. It is known by the name of Brown's Fall, and is remarkable for the the soft beauties which it presents. Essentially different from the St. Anthony's, it appears as if all its native wildness had been removed by the hand of art. A small, but beautiful stream, about five yards wide, flows gently until it reaches the verge of a rock, from which it is precipitated to a depth of forty-three feet, presenting a beautiful parabolic sheet, which drops without the least deviation from the regular curve, and meets with no interruption from neighboring rocks, or other impediments, until it has reached its lower level, when it resumes its course, without any other difference than that produced by the white foam which floats upon its surface. The spray, which this cascade emits, is very considerable, and when the rays of the sun shine upon it, produces a beautiful iris; upon the surrounding vegetation the effect of this spray is distinct; it vivifies all the plants, imparts to them an intense green color, and gives rise to a stouter growth than is observed upon the surrounding country. On the neighboring rock the effect is as characteristic, though of a destructive nature; the spray striking against the rock, which is of a loose structure, has undermined it in a curved manner, so as to produce an excavation, similar in form to a Saxon arch, between the surface of the rock and the sheet of water; under this large arch we passed with no other inconvenience than that which arose from the spray. There is nothing sublime or awfully impressive in this cascade, but it has every feature that is required to constitute beauty; it is such a fall as the hand of opulence daily attempts to produce in the midst of those gardens upon which treasures have been lavished for the purpose of imitating nature; with this difference, however, that these falls possess an easy grace, destitute of the stiffness which generally distinguishes the works of man from those of nature." *

Mr. Nicollet, in his beautiful map of the Upper Mississippi, has indicated, under the name of Cascade Creek, the stream which Mr. Keating has here described. It originates partly in Lake Harriet, which is connected by a strait with Lake Calhoun. Adjoining the latter, is the Lake of the Isles, and several others, which discharge their superfluous waters into the river at the great falls. Thus, there is much in the scenery of this wild and distant spot to feast the eye of taste, and gratify the lover of nature. It only remains for me to add, that the rocks which are here exposed consist of the oldest Silurian or transition lime and sandstone, bordering in geological position upon the primitive formations.

XII. Voyages on the Upper Mississippi.—I have not introduced a brief description of the Falls of St. Anthony without an object which conforms to the plan of this work. Much has been published on winter resorts for invalids of the north; but the necessity of a summer voyage or sojourn, for the drooping valitudinarian of the south, has been too often overlooked. To such a one, whom the heat of summer has wilted down, or the marsh exhalations of autumn have blighted, a voyage of two thousand miles directly north, should be looked upon with hope and favor. Every breath of the steam-engine would waft him into a cooler climate,—every turn of the paddle-wheel raise him to a higher level. But to make this change a blessing, he must not lounge in the cabin of his vessel, or steep himself in the fumes of brandy and tobacco at the bar, or doze and dream away the day in his state-room. To enjoy the fruit, he must pluck it with his own hands. He must rise with the sun; and only retire from his labors of active observation, when the long and deep shadows of the Rocky Mountains have gathered over him. He should not seek to pamper his appetite; petty annoyances must not fret him; and little hardships should rather be invited than shunned; for, although inconvenient at the moment, they contribute in the end to the great object for which he travels. He ought to sojourn successively in the

* Long's Expedition to the Source of the St. Peters, Vol. I, p. 295—302.

various young and flourishing towns to which he will be brought, and study their character and prospects; visit the mines through which the Mississippi has cut its way; descend into their shafts, and see the ore detached from its parent rocks; sally out upon the rolling prairies with his gun, and give scope to his natural instinct for hunting; or, turning from animals to plants, fill his port-folio with wild flowers, unlike those of the savannas of the south Lastly, he should watch the unfolding scenery, as modified by geological conditions, and contrast the low and unstable alluvial and tertiary banks of the south, with the lofty out-croppings of older and deeper rocks in the north; which, even unsmitten by the prophet's rod, pour out fountains of cold water, to fall in sparkling cascades, until they mingle with the Upper Mississippi, the most beautiful of all our rivers.

CHAPTER VII.

THE SOUTHERN BASIN, CONTINUED.

MEDICAL TOPOGRAPHY OF THE REGIONS WEST OF THE GULF AND OF THE MISSISSIPPI RIVER.

WE must return to the shores of the Gulf of Mexico, and rise again to the north. Keeping on the western side of the Gulf and of the Mississippi River, the region to be described extends from the basin of the Panuco to the uppermost tributaries of the Mississippi, in one direction; and from the shores of the Gulf and the banks of the Mississippi, to the Rocky Mountains, in the other. This vast region is traversed by a great number of rivers, of which, those south of Red River pour their waters into the Gulf,— those north, with itself, into the Mississippi. Adhering to the plan of a hydro-topographical description, we must ascend the most important of these rivers, and add to their general description some brief notices of such localities as are of public interest, or fitted, by their salubrity or sickliness, to illustrate the connection between the surface of a country and its endemic diseases. At first view, this undertaking appears to be of great magnitude; and so it would be, if these immense regions were peopled like many other portions of the Interior Valley; but the larger portions of them are still a wilderness, and may be dismissed with a few general remarks. This chapter, moreover, will be kept from any great expansion, by a different cause — the want of appropriate materials for topographical description. In proceeding to execute it, under these limitations, I shall, as already intimated, commence in the far south.

SECTION I.

REGION SOUTH OF THE RIO DEL NORTE.

The close approximation of the Cordilleras to the Gulf of Mexico, from Yucatan to the Rio del Norte, may be seen by a reference to *Pl. I.* The narrow zone which stretches from the base of the former to the shores of the latter, comprises the *Tierras Calientes*, or hot countries, of the Mexicans. Within the tropics it is restricted to a breadth of thirty or forty miles; but before we reach the Del Norte, in N. Lat. 26°, it widens to a hundred. In the south it belongs to the state of Vera Cruz, in the north to Tamaulipas, formerly Santander. The maritime towns of Vera Cruz and Tampico, already described, lie within these states. The southern and hottest portion of the zone, is low and level; abounds in blown sands, lakes, and lagoons; has very little fertility, and supports but a limited population. The northern ranges of the Tierras Calientes, while they suffer less from tropical heats, have a richer soil and greater breadth. The rivers of this more favored portion are, the Panuco, Tamissee, Santander, and Fernando, which descend from the flanks of the Cordilleras, and refresh the plain on their passage to the Gulf. Thus fertilized, the population of the northern parts of the zone, is greater than of the southern; but of the degree in which they are infested with autumnal fever, or of the modifications which it presents, I am unable to speak.

In the rear of this zone, we come to the *Tierras Templadas*, or temperate countries. They comprehend the *Sierra Madre*, and other mountains which flank the Cordilleras, and at the hight of from four thousand to six thousand feet, present terraces on which stand the cities of Jalapa, San Luis Potosi, and Saltillo. In vegetation and climate this zone differs essentially from that beneath, and it enjoys a remarkable exemption from the fevers which infest the Tierras Calientes. Behind, and at an increased elevation, are the *Tierras Frias*, or cold countries, of which the elevation is above seven thousand feet, and the productions and diseases of a kind corresponding with the temperature. Thus, in ascending from the Gulf under any parallel of latitude, a distance of two hundred miles carries us from the suffocating heats and pestiferous exhalations of the Tierras Calientes, to regions which, although never very cold in winter, are delightfully temperate and healthy in summer. This limited range between the maximum and minimum temperatures of the year, broadly distinguishes the effects of elevation under the same parallel, from those of higher latitude, in ascending the Interior Valley from the Gulf of Mexico. For example, if we advance to the north so far as to find a summer equally cool with that of the Tierras Templadas, we have a winter too rigorous to be borne — the range between those two seasons becoming longer as we proceed from the tropical zone. Within the basin of the small Rio Fernando, or Tigre, which traverses the northern part of the Tierras Calientes, there are two towns, Monterey and Saltillo, which merit a more extended notice than I am able to give them. I shall say a few words of the former only.

MONTEREY — near the twenty-sixth degree of north latitude—stands at an elevation of about fifteen hundred feet above the sea. Doctor Proctor, in his account of the diseases of a portion of the army, in 1846 and 1847,* speaks of the troops as being encamped near the city, in a low bottom, abundantly watered, and surrounded by swamps. This condition of the surface sufficiently explains the prevalence of intermittent fever, which they experienced.

SECTION II.

BASIN OF THE RIO DEL NORTE.

I. The origin, course, and termination of this river, the longest, except the Mississippi, which throws its waters into the Gulf of Mexico, has been given at page 14. Its lower half constitutes the dividing line between the United States and the Republic of Mexico. According to Doctor Gregg,* the Del Norte is a broad, shallow stream, eminently alluvial, and abounding in sandbars and snags. Its direct descent from the Rocky Mountains gives it many rapids and ripples, so that its navigation is of little value; which, taken in connection with the sterility of much of the country through which it flows, will prevent the population of its banks and bottoms — at present sparse — from ever becoming very dense. These banks in many places are not more than ten feet above low water-mark, and yet, so great is the breadth of channel, that the water does not rise high enough to overflow them. In fact, the Del Norte has but few tributaries, and in its descent loses so much water by infiltration through the sand, that its depth rather diminishes than increases with its progress; thus reversing the law which governs the Mississippi. About the middle of its length, portions of it, in long droughts, sometimes entirely disappear by absorption.

The geographical position of the Del Norte gives it an etiological importance, which will be appreciated when its topography, climate, and diseases are better known than at present. This importance results from its valley being the natural terminus on the south-west of the vast plains which

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* West. Jour. (Louisville), June, 1848.

† Com. of the Prairies, Vol. I, p. 138.

lie between the Mississippi and the Rocky Mountains. Even before reaching it from the north, detached ridges of that chain are encountered; while immediately beyond, the flanks of the Cordilleras of Mexico are close at hand. As many years will elapse before there will be much population near the base or on the slopes of the great mountain chain in higher latitudes, we must look to the Del Norte for those modifications which diseases undergo from change of topographical elevation.

The valley of the Del Norte, below the Presidio del Rio Grande, about the twenty-eighth degree of north latitude, has a general aspect of levelness, with tracts of swamp, and some small lakes of salt water. In general the soil is not deep, and in some parts so poor and sandy that the country is almost a desert. Prairies are common; the forests are thin, and composed of stunted trees; the prickly-pear (*Cactus*) infests the surface, and everywhere good water in the form of springs or streams is wanting.

II. MATAMORAS.—This Mexican town stands on the right bank of the Rio del Norte, fifty miles, by its meanders, from the Gulf of Mexico. The river, at the town, and below, as I am informed by Doctor Langdon, who, during the late war, was for some time stationed at Matamoras, is narrow, muddy, rapid, and eddying; on the whole, it resembles the Mississippi; even, like it, having no tidal estuary. The country on each side, from the mouth of the Del Norte to the town, and above, is level and sandy, with groves of small timber and an abundant growth of the prickly-pear. Immediately above the town, the river turns from its general south-eastern course, to the east; and after making a bend of many miles, returns below the town, on the south, so near as to be in sight. In this bend there is a small, permanent lake, or pond, which occasionally in river floods extends its area to the edge of town. To the west of the town there is a larger lake, about two miles long, which becomes dry in the month of August. To the north and south of this lake, the ground is a little more elevated than that on which the town is built, and covered with small trees. On the whole, there seems to be but little drowned or swampy land in the vicinity of Matamoras. It does not appear to be liable to yellow fever. Of the extent to which its inhabitants are subject to autumnal fever, I cannot speak. The troops had both intermittent and remittent fevers, but not to any remarkable degree; and their types were nearly the same that Doctor Langdon had been accustomed to see in the neighborhood of Cincinnati.

III. PRESIDIO DEL RIO GRANDE — SANTA ROSA — MONCLOVA.— In the absence of materials for a methodical topographical description of the region on each side of the Lower Del Norte, I may give the following extract of a letter, written from Monclova, in Mexico, by Doctor Gregg, who was attached to the army commanded by General Wool:

"I have been surprised during our march, to hear of a considerable amount of intermittent fever among the Mexicans. At *Presidio del Rio*

*Grande** (in N. Lat. 28° 20′ and W. Lon. 100° 30′), a town of some two thousand inhabitants, many of the natives were suffering with chills and fevers, up to the middle of October, the time of our being there. Eight or ten days afterwards, I found the same disease still more prevalent (though by no means as bad as in many parts of the Valley of the Mississippi during autumn), in Santa Rosa, a town of near three thousand inhabitants, in about N. Lat. 27° 54′, and (approximately) in W. Lon. 101° 40′. The Presidio is situated virtually in the valley of the Rio Grande (being only five miles west of it, on a small tributary); but Santa Rosa is entirely inland, being at the eastern base of a lofty and extensive ridge of mountains, which divides the waters of the Rio Grande from those of the interior of Mexico. Since leaving Santa Rosa, we have never been entirely out of sight of mountains; and at this place (Monclova) we are completely surrounded by them, though the city itself is in the border of an extensive valley, looking to the northward. But even here (N. Lat. 26° 54′, W. Lon. 101° 37′) I find the people afflicted to some extent with the same fever. Now, Santa Rosa and Monclova, with the intervening and surrounding country, certainly do not, *naturally*, abound in the conditions to which, by observation, we are led to ascribe autumnal fever; and I am disposed to attribute the fever which now prevails to an *artificial* cause. Irrigation, you are aware, is extensively resorted to in all the agricultural operations of this people, who cultivate sugar, cotton, and Indian corn, in abundance, but are obliged to depend on irrigation. If the surplus water were returned to the streams by ditches, there would, perhaps, be but little malaria produced; but it is generally suffered to run into the lower flats, and give origin to permanent ponds and marshes. There are marshes below the Presidio, more extensive ones about Santa Rosa, and many of considerable size in the vicinity of this city; all of which appear to have been produced in the manner I have pointed out."

In ascending to what may be called the Middle Rio del Norte, the country becomes more elevated and broken.

IV. CHIHUAHUA — the capital of the state of Chihuahua — stands on the banks of the Conchas, a small, western tributary of the Del Norte. "Although situated about one hundred miles east of the main chain of the Mexican Cordilleras, Chihuahua is surrounded on every side by detached ridges of mountains, but none of them of great magnitude. The elevation of the city above the ocean is between four and five thousand feet; its latitude is 28° 36′ N.; and its entire population numbers about ten thousand souls." † I am not informed as to the prevalence of autumnal fever in this locality.

V. FROM CHIHUAHUA TO THE EL PASO DEL NORTE.— The latter town or settlement, is found on the western side of the Rio del Norte, two hundred and thirty miles north of Chihuahua, and two hundred and twenty below

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* Rio del Norte.

† Com. of the Prairies, Vol. II, p. 114.

Santa Fé. The character of the middle portion of the basin of the Rio del Norte, may be understood from the following paragraph, by Doctor Gregg:* "The road from El Paso south is mostly firm and beautiful, with the exception of the sand hills before spoken of; and is only rendered disagreeable, by the scarcity, and occasional ill savor of the water. The route winds over an elevated plain, among numerous detached ridges of low mountains — spurs, as it were, of the main Cordilleras, which lie at a considerable distance to the westward. Most of these extensive, intermediate plains, though in many places of fertile-looking soil, must remain wholly unavailable for agricultural purposes, on account of their natural aridity, and a total lack of water for irrigation." Doctor Gregg does not tell us whether this region is infested with autumnal fever.

VI. El Paso del Norte.—This locality is the most attractive in the valley of the Del Norte. It will have at last the densest population, and prove to be that in which the most interesting observations on the diseases of that valley will be made. According to Mr. Hughes, † "the settlement of the El Paso extends from the falls of the Rio Grande on the north, to the Presidio on the south, a distance of twenty-two miles; and is one continuous orchard and vineyard, embracing in its ample area an industrious population of at least eight thousand." It is "isolated from all other Mexican settlements by the mountains which rise on the east and west, and close in to the river on the north and south. The breadth of the valley is about ten miles." It is irrigated by water taken from the Del Norte above the scattered village of El Paso. The freshets of the river do not overflow this bottom. The surrounding highlands are generally destitute of timber. In latitude, the Paso is a little below the thirty-second degree north.‡ According to Kendall, the population of this oasis of the desert, is chiefly Spanish, unmixed with Indian.|| Of its autumnal fevers, I cannot speak, from want of information.

VII. Santa Fe.—We ascend to Santa Fé by passing through a country but thinly inhabited. This town, well known as the capital of New Mexico, stands in N. Lat. 35° 41′, and in W. Lon. (about) 106°. Its elevation above the ocean is estimated at seven thousand feet.§ According to Doctor Gregg,¶ "its situation is twelve or fifteen miles east of the Rio del Norte, at the western base of a snow-clad mountain, upon a beautiful stream of a small mill-power size, which ripples down in icy cascades, and joins the river some twenty miles to the south-westward. The population of the city itself but little exceeds three thousand; yet, including several surrounding villages, which are embraced in its corporate jurisdiction, it amounts to nearly six

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* Com. of the Prairies, Vol. II, p. 83.
† Doniphan's Expedition, p. 282.
‡ Com. of the Prairies, Vol. II.
|| Narrative of the Texan Expedition, Vol. II.
§ Com. of the Prairies, Vol. I, p. 144.
¶ Ibid.

thousand souls." This is something more than the population of the entire province of New Mexico, as estimated by Doctor Gregg. The great obstacle to a dense population in this region is the want of water; and hence nearly all the agriculturalists live along the Del Norte or its few tributaries, and resort to irrigation. In such a region, ponds and marshes are, of course, nearly unknown; and the diseases to which they give origin, almost as rare, as will appear from the following statement, by Doctor Gregg:*

"Salubrity of climate is decidedly the most interesting feature in the character of New Mexico. Nowhere — not even under the boasted Sicilian skies — can a purer or a more wholesome atmosphere be found. Bilious diseases — the great scourge of the Valley of the Mississippi — are here almost unknown. Apart from a fatal epidemic fever of a typhoid character, that ravaged the whole province from 1837 to 1839, and which, with the small-pox that followed in 1840, carried off nearly ten per cent. of the population, New Mexico has experienced very little disease of a febrile character; so that as great a degree of longevity is attained there, perhaps, as in any other portion of the habitable world. Persons, withered almost to mummies, are to be encountered occasionally, whose extraordinary age is only to be inferred from their recollection of certain notable events, which had taken place in times far remote."

Santa Fé, of which this favorable account is given, lies under the same parallel with Memphis and the southern portion of the St. Francis Bottom; which were described in the last chapter as having an elevation of three hundred feet above the sea, with an excess of moisture, and abounding in autumnal fevers of a fatal character.

VIII. Valley of Taos.—The last locality within the basin of the Rio del Norte, which I shall mention, is Taos, lying above Santa Fé, in N. Lat. 36° 20′. The stream which flows through this valley, enters the Del Norte by its left bank. The settlements in this valley are among the most northern of that river. According to Doctor Gregg,† "no part of New Mexico equals this valley in amenity of soil, richness of produce, and beauty of appearance." As this distant region (it may be hoped) will hereafter be visited by certain classes of invalids, I will transcribe from Doctor Gregg, the following notice of a natural curiosity:‡ "Opposite Taos, for an uninterrupted distance of fifteen miles, the Rio del Norte runs pent up in a deep *cañon* (gorge), through which it rushes in rapid torrents. This frightful chasm is absolutely impassable; and viewed from the top, the scene is imposing in the extreme. None but the boldest hearts and firmest nerves can venture to its brink and look down its almost perpendicular precipice, over projecting crags and deep crevices, upon the foaming current of the river, which in some places appears like a small, rippling brook."

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* Com. of the Prairies, Vol. I, p. 146.

† Ibid, p. 145.

‡ Ibid, p. 138.

We must now take leave of these detached and extreme western settlements, of the Great Interior Valley, and return to regions nearer the Gulf of Mexico.

SECTION III.

SOUTHERN TEXAS.

Between the Lower Rio del Norte and the Lower Mississippi, there is a region watered by the following rivers, beginning to the south-west:— Nueces, San Antonio, Guadalupe, Colorado, Brazos, San Jacinto, Trinity, Neches, and Sabine; not to mention smaller intervening streams. The longest of these numerous rivers are limited to the north by the water-shed between them and Red River, which, behind the state of Texas, runs nearly from west to east, about the thirty-fourth degree of latitude; the shorter ones arise much nearer the Gulf; into the numerous shallow bays and sounds of which, they all discharge their waters, between the latitudes of twenty-seven and a half and thirty degrees north. It is the north-west segment of the Gulf which receives these contributions—more copious than those poured into any other equal portion of its coast, from the Delta of the Mississippi round to Yucatan; a sufficient evidence that the region from which they flow, is neither so deficient in rain, nor abundant in absorbing sands, as that of the Rio del Norte further west.

Not having visited any part of this group of river basins, nor seen their medical topography described, I cannot speak of them except in the most general terms. Mrs. Holley* informs us that Texas, as it was then bounded, by the Nueces to the west, and Red River to the north, presents three zones or regions,—the level, the undulating, and the hilly. The level occupies the entire coast, extending from thirty to eighty miles into the interior, and corresponding, except in latitude, to the Tierras Calientes of the western side of the Gulf. The whole Gulf-margin of this zone, from the Nueces to the Sabine, has a belt eight or ten miles wide, consisting of prairie, except along the streams. Although low and extremely level, it is almost free from marshes. That part of the level region which extends back between the San Jacinto and Sabine Rivers, about seventy miles from the coast, is in general heavily timbered. The section of level country which lies between the San Jacinto and Guadalupe, extends back about eighty miles; is sufficiently elevated for perfect drainage after rain; and presents few swamps or ponds. The bottom lands of the Brazos, San Bernardo, and Colorado, are from three to twenty miles in width, and heavily timbered, presenting cane-brakes of

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*Texas. By Mrs. Mary Austin Holley: Lexington, 1836. This late accomplished and gifted lady, a niece of Moses Austin, the pioneer of the American emigrants to Texas, resided for some time in the region she has described.

immense extent. That portion of the level land which lies between the Guadalupe and the Nueces, is narrower, but at the same time more elevated, than the regions just described.

We come now to the undulating zone. Between the Sabine and San Jacinto Rivers, the country is undulating to Red River, on its north, and never rises into ridges higher than those which belong to a rolling country. It is partly wood-land and partly prairie,— everywhere well watered. North of the level country from the San Jacinto to the Guadalupe, the surface is gently undulating, diversified with prairie and forest, and abundantly supplied with permanent springs. West of the Guadalupe to the Nueces, a similar surface is found. We come now to the third division.

"The mountain range of Texas may very properly be called a spur of the Sierra Madre (Mother Ridge), which it leaves near the junction of the Rio Puerco with the Del Norte, and, pursuing a north-easterly direction, enters Texas at the sources of the Nueces River. Thence, continuing in the same direction to the head waters of the San Saba, a branch of the Colorado, it inclines to the east down the San Saba; crossing the Colorado some distance below the mouth of that river, it is finally lost in the undulating lands of the Brazos. This range does not cross the Brazos. The country east of this river and upon Trinity River is gently undulating, and in some districts quite level; this description of surface extending the whole distance to Red River. Spurs of this mountain range extend southwardly, down the rivers Madina and Guadalupe, to the vicinity of Bexar. Spurs also extend down the rivers Slanos and Pedernales, and the smaller western tributaries of the Colorado. Similar spurs stretch up to the Colorado above San Saba to a considerable distance, and round the head-waters of the San Ardress and Bosque, tributaries of the Brazos.

"The mountains are of third and fourth magnitude in point of elevation. Those of the San Saba are much the highest. These are, in many places, thickly covered with forests of oak, cedar, and other trees, interspersed with a great variety of shrubbery.

"This range of high land on its north-western frontier, is of vast advantage to the state of Texas. It not only renders the atmosphere more salubrious, but, abounding in copious fountains of limpid water, it gives rise to the numerous rivulets which, having first irrigated their own fruitful valleys flow off with a rapid current, and unite to form the large rivers of the central and western parts of the state. These last-mentioned rivers are uniformly more limpid than the rivers to the east of the Brazos.

"North of this mountain range, and on the extreme head-waters of the Brazos River, the country becomes level again and presents to the view interminable prairies. These stretch to the north and north-west beyond Red and Arkansas Rivers, and are finally lost in the vast ocean of prairie that terminates at the foot of the Rocky Mountains." *

* Texas, by Mrs. M. A. Holley, p. 21—23.

This outline of the physical geography of Texas, even if not too favorably drawn, lays but a foundation for its medical topography; and even on this foundation, for want of the requisite materials, I cannot build. I can, however, give an additional and corroborative notice of one portion of this extensive region, in an extract of a letter from Doctor Gregg:* "The general character of this country, to the southward, that is, between this and the coast, is level — chiefly high and dry plains, with fertile soil, abounding in vegetable remains; in many places, alluvial; in others, more elevated, containing silicious pebbles. These plains appear to be based on what I have always called *rotten* limestone, a soft, friable, semi-decomposed carbonate of lime (tertiary or cretaceous). But to the north we have a hilly or low mountainous region, with strata of firmer limestone. At the base of these hills the San Antonio takes its rise, by numerous springs of pure water, one of which is exceedingly copious, and, during the month I have been here, has had a daily morning temperature of seventy-six degrees, and an afternoon temperature of seventy-eight degrees, Fahrenheit. This is a very healthy region of country, I am sure; yet I find some autumnal fever among the inhabitants, and still more is occurring to the troops; but they have been marching through more insalubrious regions. The town stands in Lat. 29° 25′ 30″ N., and Lon. 98° 50′ W. Its population is about two thousand — chiefly Mexican. This place is so far west that the nights in summer and autumn are dry. I am disposed to think that it is near the western limit of the epidemic prevalence of autumnal fever."

SECTION IV.

VALLEY OF RED RIVER.

I. General Description.— We have taken leave of the rivers which, to the west of the Gulf and the Mississippi, flow directly to the former; and reëntering the Mississippi basin, will ascend; and must now advance gradually through its western half, to the northern limits of its settlement.

Red River, a large, and the most southern, tributary of the Mississippi, mingles its reddish-colored waters with the chocolate-tinted currents of the Great River, in the N. Lat. 31° 2′ 25″, at the vertex of the Delta. In consequence of its low latitude, and its flowing nearly east for the first half of its length, Red River throws out its annual flood in the month of February; while the more northern tributaries of the Mississippi are still locked up. In tracing the course of the river from its mouth to its sources, we pass to the north-west, and very soon to the west, until we reach the Llano Estacado, on which it chiefly originates. Restricted to the north by the river Arkansas,

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* Dated, San Antonio de Bexar, September 25th, 1846.

and on the opposite side by the rivers of Texas, which flow directly south to the Gulf, the basin of this river is long, narrow, and, near its middle, bent almost to a right angle. It is chiefly the portions below this bend, within the limits of the state of Louisiana, that present at this time anything of interest to the medical topographer. Throughout its upper half, its annual swell pours, through numerous outlets, and over its low banks, a deluge of water, which collects into lakes or reservoirs on both sides of the river, and thus diminishes the inundation. When the river sinks in summer and autumn, most of these safety-basins, by outlets from their lower sides, send back their waters to the river, and many of them even have their bottoms covered with grass. The distant highlands on both sides, are tertiary or cretaceous pine terraces, which extend down to, or below, the town of Alexandria, one hundred miles above the junction of the river with the Mississippi, where they trend away to the north-east from the left bank of the river, and to the north-west from its right; and thus the valleys of the two rivers are blended into one, in which the deposits of the two rivers are distinguishable — those of the Mississippi being some shade of blue, and those of the other streams, a tint of red. In all other respects, their medical topography is so much the same as to render a further description unnecessary.

The streams generally, which, from the north, fall into Red River below the great bend, are limpid; but those of the south, and many of its upper tributaries on both sides, have a reddish turbidness, and a brackish taste, from traversing rock-salt formations. The redness is from clay, colored with peroxyde of iron, the saltness from muriate of soda — both of which impregnate its alluvial soil, and are regarded as the elements of its unrivaled fertility.* We must now notice a few localities.

II. Alexandria.—This town occupies the right bank of the river, at the foot of its rapids, in the parish of Rapide, distant from New Orleans three hundred and thirty-six miles, and from the mouth of Red River about one hundred. The plain on which it stands rises above high water, but gradually sinks to the cypress-swamp level, and continues so for fifteen or twenty miles back from the river. Immediately above the town is the foot of the rapids, which, when the river is low, cause the navigation to terminate at Bayou Rapide. The banks of this bayou are sufficiently elevated for cultivation. Alexandria suffers equally with the towns of the upper part of the Delta from autumnal fever, and has once been visited by yellow fever.

Pine Lands.—Opposite Alexandria the pine lands approach to the very shore of Red River. This plateau is handsomely undulated with hill and dale, and in the valleys there burst out innumerable springs. The streams have transparent water, flowing generally over white sand. The soil is comparatively poor, except the narrow intervals of the streams, which abound in magnolias, flowering shrubs, and climbing vines, with the speckled trout in

* Darby and Flint.

the shaded waters beneath. Finally, the air has a balmy and terebinthine odor.* These pine woods, like those nearer the Gulf, already described, are proverbial for their freedom from autumnal fever.

III. NATCHITOCHES.—This old, originally Spanish, town is situated on the right bank of the river, eighty miles above Alexandria, in N. Lat. 31° 46′; and, in consequence of the rapids which have been mentioned, cannot be reached by steamboats when the river is low. According to Flint, it is beautifully situated on a well-developed river bank, and extends back to a pine bluff, with fine scenery around it. I have not materials for a fuller description. The yellow fever has never, as far as I can learn, visited this town; though, according to Doctor Monette, cases have occurred in persons arriving there from New Orleans; nor is autumnal fever very violent.

Mr. Darby† informs us that, in the neighborhood of this town, we first meet with the pecan, white-flowering locust, and red cedar, in ascending from the Gulf of Mexico.

IV. FORT JESUP.—This post, established in 1822, is situated south-west of Natchitoches, on the dividing ridge between Red River and the Sabine, about twenty-five miles from each. The surrounding forest is composed of pine, with an intermixture of oak and hickory. The surface is rolling, and somewhat rugged; the geological formation, tertiary. Along the neighboring streams there are narrow bottoms, with a dark, tenacious soil, shaded with beech, sassafras, mulberry, and cypress. Its latitude is 31° 30′ N., longitude 93° 47′ W.; its distance in a direct line from the Gulf, one hundred miles. The annual ratio of intermittent fever is twenty-four per cent.; of remittent, seven.‡ The yellow fever has not invaded it.

This is the most southern of a range of military posts lying west of, and at a distance from, the Mississippi. The others, and more northern, are Forts Towson, Smith, Gibson, Leavenworth, and Calhoun. Passing by the flourishing town of Shreveport, which I have not the means of describing, we come to

V. FORT TOWSON.—The latitude of this post is 33° 51′ N., its longitude 95° 1′ W. Its site is six miles north of Red River, above the great elbow bend. The Kiamichi, a tributary of that river, passes within the same distance of the fort, to the south-east. In front of the post the ground descends gradually for a mile, when an undulating prairie, of great extent, begins. Immediately in the rear there is an abrupt descent of eighty feet into the valley, which varies in breadth from a few yards to half a mile, and is bounded on the opposite side by rolling tertiary or cretaceous hills, densely covered with oak and pine. Through this valley, which is wooded, and has a marshy surface, there flows a small tributary of Red River. The soil around the

* Flint's Recollections.

† Statistics of Louisiana.

‡ Med. Stat., U. S. A., p. 237.

fort, composed of sand and clay, is not very productive. The annual prevalence of intermittent fever at this post is one hundred and fourteen per cent.; of remittent, twenty. It has not suffered from yellow fever.

VI. The Washita.—This great tributary of Red River has acquired a notoriety which claims for it a more extended notice than I have the means of giving. Its origin is in the Ozark Mountains, there called the Washita Hills, immediately north of the great bend of Red River, a little below the latitude of thirty-four degrees. Taking at first an eastern direction, it turns at length to the south-east, and then to the south, when it descends into the Concordia Bottom (*Pl. VII*), and, under the name of Noire or Black, enters Red River about thirty miles from its mouth. Its great tributaries to the east are Saline River, joining it some distance up, and the bayous Bœuf, Macon, and Tensas, which unite with it in the Mississippi bottom. On the western side it receives, nearly opposite these bayous, the Catahoola, or Little River, which has traversed Lake Catahoola; and higher up, among minor streams, the Dorbone, and Little Missouri.

Thus the upper portion of this river is in hill lands, and its middle near the junction of the hill lands with the Concordia Bottom, where it flows in such a direction that, while its right bank looks to the highlands, its left is to the bottom, into which it finally descends. Being then joined by the bayous just mentioned, it loses the character of an upland stream, and, filled with the redundant waters of the Mississippi, in spring and summer overflows its banks far and wide.

In its topography and autumnal diseases, this lower portion of the Washita is so much like the lower portions of Red River and the Mississippi, that a separate notice is not demanded; and as there is not on its banks any town of interest, we may pass to the region of its upper waters.

VII. Hot Springs.—Among the upper waters of the Washita, in N. Lat. 34° 31′ and W. Lon. 92° 50′ 45″, near the base of the south-eastern slope of the Ozark Mountains, about six miles north of the Washita River, lie the celebrated Hot Springs.* According to Nicollet,† their elevation is seven hundred and eighteen feet above the Gulf of Mexico; the altitudes of several neighboring ridges being nine hundred and ninety-seven, eleven hundred and sixty-two, and fourteen hundred and six. The springs are about seventy in number, and burst out near each other in the same valley. In temperature, they range from ninety-two to one hundred and fifty-one of Fahrenheit. They are limpid, emit no bubbles of gas, and have no particular taste. Like many other hot springs, they hold silex in solution; for they deposit a tufa which is composed of that earth, with lime and oxyde of iron.‡ The surrounding rocks manifest more or less of a volcanic character, as I am

* Major Long's Expedition to Rocky Mountains, Vol. II, p. 289, etc.

† Hydrograph. Basin.

‡ Expedition, Ibid.

informed by Doctor Warder, who has specimens of them in his cabinet; and according to Colonel Long, many of them are in strata highly inclined to the horizon. The scenery of this region has an aspect of wildness and grandeur, and its summer and autumnal salubrity is unquestionable.

For the people of the far south, the Washita Springs might be made an interesting summer resort, as this is their nearest mountain locality; and to invalids of the southern part of the Interior Valley whose diseases require a resort to hot springs, those of the Washita are far more convenient than the hot springs on the mountains of Virginia. If our physicians would turn the attention of their patients to this locality, the only objection — a want of comfortable accommodations — would soon be obviated.

SECTION V.

THE ARKANSAS RIVER.

I. General Topography.—The distant origin, in the Rocky Mountains, of this great tributary of the Mississippi, has been already given in treating of our hydrographical axes. It is, essentially, an alluvial river. In traversing the boundless plains between those mountains and the Mississippi, most of its southern tributaries, and especially Canadian River, pour in currents of salt water, colored red with the ocherous clays which belong to the rock-salt strata, while others throw in sand and blue clay. Thus, its alluvial deposits, before it reaches the Mississippi, exhibit considerable variety. Below Little Rock, cretaceous pine bluffs approach its right-hand bank, the bottoms on the opposite side being low and broad. At length these hills recede, and its alluvial plains blend themselves with those of the Mississippi, and abound in lakes, bayous, and swamps, which are annually replenished by the spring floods. The junction of the two rivers is about in N. Lat. 33° 40′ and W. Lon. 90° 34′.

In ascending the river, after passing Little Rock, the traveler enters the range of Ozark Mountains, through which, without falls or even rapids, the river makes its way. At Fort Smith, nearly three hundred miles up, he still finds a rugged country; but at Fort Gibson, one hundred miles further, and about six hundred and thirty miles from the mouth of the river, the mountains have ceased, and the prairies, which stretch away to the Rocky Mountains, are seen on every side. That portion of the valley which traverses the hill country is much narrower than that below, and the bottoms are far less liable to inundation. The deposits which are made upon them by the freshets of the river abound in common salt, and the water which is left behind contains a great deal of that salt in solution; which, Mr. Nuttall supposes, checks the progress of organic decomposition in summer and autumn, and diminishes the prevalence of intermittent and remittent fevers.*

Of that, the longer, portion of the river which lies beyond Fort Gibson, in the great prairies, I need not speak, as its banks are almost uninhabited.

II. LITTLE ROCK.—Of the most important town in the valley of the Arkansas, I can say but little. Its latitude is 34° 45′ 25″ N.,—its elevation above the level of the Gulf, three hundred and thirty-two feet—that of Big Rock, three miles above, six hundred and eighty.† Thus the town of Little Rock is beyond the limits of the alluvial beds of the Mississippi. In fact, there are on the south side of the Arkansas a series of cretaceous bluffs, below the town. On the immediate topography of this locality I cannot speak for want of facts. It has never been visited by yellow fever; and is not, I believe, greatly infested with intermittents and remittents, considering its latitude, and the contiguity of the river.

III. FORT SMITH.—The site of this post, in N. Lat. 35° 22′, and W. Lon. 94° 10′, is the right bank of Arkansas River, which, at that point, flows directly north. A tributary passes near the fort, on it south side, and enters the river just above it. Small lakes and marshes abound in every direction, some of which are subject to inundation from the river. The terrace on which the fort stands is about fifty feet above the alluvial plains, and consists of a dark-colored, slaty, micaceous sandstone.‡ The country beyond the bottom lands is broken, with some eminences which are almost mountainous.||

The returns from this post indicate a decided prevalence of autumnal fever, especially the intermittent form, the annual ratio of which is one hundred and seven per cent.; that of remittents, fourteen. In the autumn of the year 1823, there prevailed a malignant fever, which put on many of the symptoms of yellow fever, of which more will be said in the history of that disease.§

IV. FORT GIBSON.—The latitude of this post is 35° 48′ N., its longitude 95° 9′ W. It is situated on the left bank of the Neosho River, a northern tributary of the Arkansas, three miles above their junction. Its site is a low bottom; and about a mile and a half to its south south-west, between the two rivers, their lies a small lake surrounded with marshes. The descent to this lake from the fort is very little, and hence the latter is badly drained. This bottom, including the place where the fort is built, was a cane-brake. Cane is found also on the opposite or south side of the river, which abounds in ponds and marshes. Immediately above the mouth of Neosho River, Verdigris Creek enters the Arkansas, and adds to the alluvial grounds on

* Long's Expedition to the Rocky Mountains.—Nuttall's Travels in Arkansas.—Featherstonhaugh's Report and Excursion.

† Nicollet: Hydrograph. Basin.

‡ Nuttall's Travels.

|| Med. Stat. U. S. A.

§ Ibid.

the west. For three-fourths of the distance round it, this locality is environed by elevated prairies, terminating in a range of hills. As might be expected, the army reports represent this as a very sickly post in autumn—the *most* sickly, indeed, in the whole Interior Valley, except, perhaps, Fort Jackson, below New Orleans; the annual average being, for intermittents one hundred and twenty, for remittents, twenty-five per cent.*

SECTION VI.

THE OZARK MOUNTAINS.

In advancing by a single step through four degrees of latitude, from the Arkansas to the Missouri River, it is is proper to make a few general remarks concerning the country between them. This has been already done for its eastern margin, as we ascended the Mississippi; when we saw that, from the mouth of St. Francis River to that of the Missouri, more than six hundred miles, no considerable stream enters the common trough. Of the whole, the Maramec, below St. Louis, is the largest, but does not present anything of interest to the medical topographer.

The Arkansas, nearly as high as we ascend it, flows through the state of Arkansas; and the Missouri, in like manner, advances to the Mississippi through the state of Missouri. As we leave the right bank of the Mississippi, and advance westwardly between these rivers, we are everywhere on high, rolling, forest land; which at length rises into the Ozark Mountains, the position and outline of which were sketched in Chapter I, and may be seen on the map of the Valley. On the flanks of these mountains lie the celebrated lead, iron, and copper mines of Missouri, mostly west of Ste. Genevieve. To the south, these mountains send down branches of the River St. Francis, the whole of White River, and some small tributaries of the Arkansas, which join it above Little Rock. To the north, they throw off the Maramec, which finally turns to the east, and unites with the Mississippi; also the Gasconade, and large branches of the Osage, which flow to the Missouri. This elevated hydrographical center of two states abounds in pure and permanent springs, is exempt from lakes and marshes, and forms a striking contrast in its topography with the broad and wet alluvial bottoms of Red River, the Washita, and Arkansas, over which we have just passed. This topographical change results from a change in the geological constitution, which is here entirely different. Loose tertiary and cretaceous deposits, easily moved about by the currents of rivers, and thus favoring the production of wide alluvial bottoms, are replaced by older and more solid strata of carboniferous and Silurian lime and sandstone, reposing upon, or around, unstratified or primitive rocks. Thus it is that mineral geology illustrates medical topography.

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*Med. Stat. U. S. A.

Of the autumnal diseases of this region, I cannot speak with much authority; but whatever I can say, is in its favor. Beyond the western slopes of these mountains, we come to the great treeless plain, which ascends to the Rocky Mountains. It begins between the ninety-fourth and ninety-fifth degrees of west longitude, that is, not far east of the western boundary of the states of Missouri and Arkansas; and there, equidistant between the Arkansas and the Missouri, we have the interlocking sources of two of their considerable tributaries, the Neosho and Osage, which flow off nearly in opposite directions.

SECTION VII.

THE MISSOURI RIVER.

I. General Description.— Having myself ascended the Missouri River to Fort Leavenworth, nearly four hundred miles, beyond which, from the sparseness of population, the banks at present offer but little interest to the medical topographer, I am enabled to speak with more confidence than of Red River and the Arkansas, which I did not explore.

According to Nicollet,* the junction of the Missouri with the Mississippi, fourteen hundred and eight miles from the Gulf of Mexico, is in N. Lat. 38° 50′ 50″ and W. Lon. 90° 13′ 45″. Its surface, at low water, is three hundred and eighty-eight feet above the Gulf. Its general course from Fort Leavenworth to its mouth is so nearly east, that the difference in latitude between the two points is only thirty-one minutes fifty seconds, and most of that difference accruesbetween Fort Leavenworth and the Kansas River, the mouth of which is only fifteen minutes thirteen seconds north of the junction of the Missouri with the Mississippi. The trough, or immediate valley, through which the Missouri flows, is from two to four miles wide; and bounded by rocky limestone hills, which rise to the hight of from one hundred to three hundred feet. The fall in the Missouri from Fort Leavenworth to the mouth of the river, a distance of three hundred and seventy miles, is, according to Nicollet, three hundred and fifty-eight feet,— nearly a foot a mile, and within thirty feet of the entire descent afterwards to the Gulf of Mexico, a distance of fourteen hundred and eight miles.

Nearly all the Missouri bottoms are on the north or left side, the river pressing against bluffs to the south or right side; as the Mississippi, below the mouth of the Ohio, presses on its bluffs to the east or left-hand side. Most of these bottoms, in occasional extraordinary floods, like that of 1844, are liable to inundation; but ordinarily, the greater part are exempt. Ponds, lagoons, and swamps are, therefore, much less common than along the Mississippi below; and from the narrowness of the valley, they are, of course,

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* Hydrograph. Basin.

much more limited. Another cause contributing to the same exemption, is the sandy and absorbing quality of the ground, which, along the Mississippi, is more resistant to percolation. On these bottoms, the cotton-tree takes the place of the cypress in the south.

The voyages of Lewis and Clark, and subsequently of Breckinridge, Catlin, and Nicollet, inform us, that from its remote sources in the Rocky Mountains, the Missouri flows down an inclined plain, the upper strata of which are in most places but slightly consolidated, and therefore easily disintegrated and transported. Much of it is, no doubt, a tertiary deposit, and a part is known to be cretaceous; thus giving us formations far in the interior analogous to those around the Gulf. It is in the passage of the Missouri and its great tributaries, especially the Yellow Stone and Platte, through these loose deposits, that its waters become thoroughly impregnated with all the mineral or organic substances they can either dissolve or suspend. To the suspension, the rapidity of the current greatly contributes; while, in floods, it also rolls or drifts onward various matters too heavy to be floated. These are chiefly sand and small gravel. Arriving at the limpid and delicately tinted Mississippi, it pours into the common channel its drab-colored and muddy torrents, to roll on for clarification in the Gulf of Mexico. I have already stated that a gallon of this water taken from the Mississippi opposite St. Louis, yielded one hundred and eighty grains of sediment, giving the remarkable proportion of one part by weight to three hundred and thirty-three of water.*

Of the drifting of sand upon its banks and over its alluvial plains, I witnessed a striking example, in ascending the river after the great freshet in 1844. For about four hundred miles, there was scarcely a single plantation in the bottoms which had not suffered; and many were entirely desolated, the sand having been spread over them, in many parts near the river, to a depth of several feet. Literally, low sand-drifts occupied the very spots on which houses and fences had stood before the inundation. In places where the current had slackened, recent deposits of silt covered the surface, which, by a single inundation, was raised several inches. The great proportion of sand in these alluvial bottoms, renders them much more friable than the argillaceous banks of the Lower Mississippi; and hence they are ever falling in, and maintaining the turbidness of the stream, which meanwhile is making new deposits and new drifts; whereby its channel is perpetually changing.

The intervals or bottom lands of the Missouri are covered with a luxuriant tree and herbaceous vegetation; and as many of them are more or less submerged by the ordinary spring floods, there is no deficiency of those surface conditions which, as we have seen in so many localities, favor the production

* This result was ascertained by Doctor Raymond, in his analysis, given on page 75. It was, strictly, Missouri water in which Professor Bailey found so great a variety of animalcules.—See p. 71.

of autumnal fever; and there is no exemption from that epidemic. On the contrary, it prevails in the bottoms and on the bluffs every year, though the number of malignant cases is not, perhaps, as great as in more southern localities of the same topographical character.

II. Osage River.— This river, the sources of which have been already indicated, after pursuing a north-east course through a rugged country, enters the Missouri by its right bank, one hundred and thirty miles from its mouth, and eight miles below the capital of the state, presently to be described. From Mr. John Johnson, who resides eighteen miles from its mouth, I learned, that the back-water of the Missouri, in 1844, ascended beyond his residence; and that the flood of the Osage itself deluged its bottoms from Warsaw down, that is, through nearly half its length. Uusually, however, it does not overflow its banks. In freshets its waters are turbid, at all other times, clear, but not so remarkably limpid as those of the Gasconade, a smaller tributary of the Missouri, entering a little lower down. The latter comes entirely from the northern slopes of the Ozark Mountains. The immediate valley of Osage River varies from half a mile to a mile in width. Its inhabitants, and those of the adjacent hills, are subject to autumnal fever; but malignant cases are rare.

III. Jefferson City — the capital of the state of Missouri—stands on a group of right-hand bluffs, one hundred and thirty-seven miles up the river. There is no interval land in front, but on the opposite side of the river there lies a bottom of the usual width, which is liable to partial inundation from ordinary floods. Directly west of the town, a creek, which has passed near it on the south, enters the Missouri. When the river is high, the back-water ascends this little stream and submerges its narrow bottoms. The country beyond this creek, and generally around the city on the south side of the Missouri, is elevated and rugged, the hills being composed of carboniferous limestone. The buildings in the city are scattered, and none of them very old. Visiting it in the latter part of August, I had an opportunity of seeing that it is subject, in a very positive degree, to autumnal fever, chiefly intermittent. I saw, indeed, malignant or congestive cases, and found that the medical gentlemen were familiar with them. Doctor Edwards informed me, that the disease prevailed as much on the city bluffs, at an estimated hight of two hundred feet, as in the bottom opposite the town; and that it was less prevalent on the margin of the bottom, than back from the river. Doctor W. Davison has observed, that the people near the creek, west of the city, both in its valley and on the adjacent hills, are more liable to fever than those farther east. He has also remarked, that the inhabitants three or four miles from the river, are more exempt than those who reside on its bluffs. Having formerly practiced medicine in the old town of Wheeling, Virginia, he was enabled to say, that his present locality was more infested with autumnal fever than the former.

IV. Boonville.— This is another bluff-town on the same right-hand bank of the river, fifty miles higher up, and one hundred and eighty-seven from the mouth of the Missouri. The bluffs, still composed of carboniferous limestone, are less rugged and much less elevated than those of Jefferson City; being, according to Nicollet, only seventy-two feet above low water mark, and six hundred and two above the Gulf of Mexico. The country around Boonville is dry and rolling, but on the opposite side of the river, there is a bottom two miles wide. Visiting Boonville and Jefferson City near the same time, I had an opportunity of comparing them, as to autumnal fever, and found it decidedly more prevalent at the latter, than the former. From Doctor Hart, Doctor Thomas, and Doctor Stockton, I learned, that the people who live near the La Mine, the Saline, and other smaller streams, which meander among the low hills around Boonville, are more subject to autumnal fever than those of the town and its vicinity. These streams have alluvial bottoms, of moderate width, which are partially overflowed by every freshet, or have portions of their surface converted into temporary swamps by copious rains. Many of them, moreover, are rendered stagnant by mill-dams. In a confined locality of this kind, seven or eight miles from the river, Doctor Thomas had seen many malignant and fatal intermittents. In an excursion with Doctor Stockton, five miles from town, into the valley of *Petite Saline*, which is a mile wide, flat, wet, and traversed by a stream, converted by dams into a series of ponds, I found the fever decidedly and fatally prevalent.

V. Franklin, Fayette, and Howard County.— Let us pass to the opposite side of the river. The older village of Franklin, one of the earliest settlements on the Missouri, has been arrested in its growth and partly depopulated by Boonville. The sandy and friable bottom on which it stands, or rather, on which it stood, is not only liable to overflows, but to extensive cavings-in of its banks. In consequence of this, a village called New Franklin has arisen on the low bluffs in its rear. Through this village, I made an excursion of twelve miles, to the town of Fayette, in Howard County. The substrata are carboniferous limestone, and the surface is low, ridgy, or rolling. A mill-stream, called the Bonne Femme, traverses the county from north to south, up which the back-water of the flood of 1844 ascended ten miles. Both the Femme and its principal branches have bottoms from a quarter to half a mile in width, which, after floods or great rains, are left wet and pondy. The town of Fayette is on rolling and sufficiently dry ground. All parts of this county,— which may be taken as a specimen of the most fertile and desirable of the wood-land portions of Missouri,— are obnoxious to autumnal fever, especially near the streams. In the month of August I saw a number of cases, some of which were malignant; and Doctor Talbot, who had resided in the county several years, testified to the annual visitations, which, although general, are much more violent near the sluggish streams than elsewhere.

VI. Arrow Rock.—This village is situated fifteen miles above Boonville, and two hundred from the mouth of the river. Like the last, it stands on a level, but more elevated, rocky bluff on the right hand, and is built a little further back from the river. Opposite to it, the Missouri bottom is liable to inundation in river floods, and throughout the year abounds more or less in ponds and sloughs. In the rear of the village, on the south side of the river, at the distance of a few miles back, runs the edge of an extensive prairie. The village of Arrow Rock, according to Doctor Price, is not greatly infested with autumnal fever. The opposite bottom, and the prairies behind the village, suffer much more.

VII. MIAMI.—This new and inconsiderable village, on a locality more hilly even than Vicksburg, or any other town we have described, is found on the right bank of the river, about fifty miles above the last. The river flows against the foot of the bluffs, and presents wide and low alluvions on the north side. Indeed, for some distance before reaching this point, the bottoms are broader, more depressed, more swampy, and bear a greater resemblance to those of the Mississippi, than the bottoms lower down the Missouri. To their vicinity it is owing, perhaps, that the village of Miami, notwithstanding its rugged site, and the absence of all stagnant water near it on the south side of the river, is decidedly liable to autumnal fever. This, in fact, is not a conjecture; for, since my visit in 1844, I have been informed by Doctor Towles, that when, in summer and autumn, the wind sets over the village from that bottom, the fever inevitably appears.

VIII. SALINE COUNTY.—This is the name of the large county in which the two last-mentioned villages are situated. The Missouri here makes a great bend to the north, and hence the distance between those villages is much greater by the river than on the chord of the arc. Except a margin near the Missouri River, slips along the branches of the La Mine (which joins the Missouri above Boonville), and copses of small trees, shrubs, and vines, scattered here and there, this county is made up of undulating prairie, which, from any point, extends in all directions to the limit of vision. Many small natural ponds, and a greater number of wet prairies, generally connected with sluggish brooks, are met with. In fact, the grass materially interferes with the ready and rapid flow of the rains which fall on the prairie surface. The sub-stratum is carboniferous limestone,— the soil fertile, black, and abounding in organic matter. The prairies of Saline County are the beginning of the great plains which stretch south to the Arkansas River, and west to the Rocky Mountains; and this description may be received as applicable to their eastern margin generally. When visiting this county in 1844, I was told by Doctor Long, of the interior village of Marshall, and by Doctors Tait and Towles, of Miami, that intermittent and remittent fevers prevail in all parts of it, but do not often assume a malignant character.

IX. LEXINGTON.—The young but rapidly growing town of Lexington, like the others, stands on the south side of the river, and is two hundred and ninety-four miles from its mouth. The Missouri washes the base of the nearly perpendicular limestone bluffs on which it is built. The elevation may be two hundred feet above the river. Immediately east of Lexington there are strata of shale, which, I presume, underlie the coal and carboniferous limestone through which we have passed from the mouth of the river; and if so, the limestone on which the town is built must be the upper Silurian. The prairies here approach within two miles of the river, and the moment we enter them, small miry and lagging rivulets, with swampy tracts, the whole having a dense covering of grass, are met with. The slip of wood-land which separates them from the river, is dry and hilly. On the north or opposite side of the Missouri, the bottom is broad, depressed, densely wooded, liable to annual inundation, and abounding in ponds and swamps, some of which are permanent. Lexington, on the whole, does not appear to be seriously infested with autumnal fever. The prairies, as in Saline County, are generally, but not violently affected. Doctor Vaughan and Doctor Vivian, of the village of Dover, near Lexington, have occasionally seen intermittents of a malignant and fatal character along the creeks up which the back-water of the Missouri flows. Doctor Flournoy and Doctor Digges, of Lexington, regard the low bottom on the opposite side of the river as more unhealthy than the town, or the adjacent prairies.

X. Mouth of Kansas River.—The bed of the Kansas River, near its mouth, is so level that its current, when the river is not swollen above the Missouri, is occasionally sluggish. On the upper side, its banks are high, — on the lower, there is an alluvial bottom of moderate width, which is liable to submersion. A mile below its mouth, at the foot of a bluff less elevated than that on which Lexington is built, is Westport Landing, where a number of families reside. On the opposite side of the river, there is a low and foul bottom of great extent, which is liable to inundation, and is but thinly peopled. In the month of August, I found a decided prevalence of autumnal fever among the inhabitants of Westport, both at the base and at the summits of the bluffs.

The western boundary of Missouri, from the state of Arkansas to the Missouri River, is the meridian of the mouth of the Kansas River, which is found, three hundred and seventy-two miles from the Mississippi, in Lon. 94° 32′ 54″ W., and Lat. 39° 6′ 3″ N. The low water-level of the Missouri is, at this point, seven hundred feet above the Gulf.* The altitude of the adjoining hills may be one hundred and fifty feet higher.

XI. Methodist Manual Labor School, and other Missionary Stations.—These establishments are found near each other, in the Indian country, a few miles south-west of the junction of the Kansas with the Missouri. The aspect of the region which they occupy is gently rolling, with intermingled prairie and wood-land, — the former predominating. Along the small streams there are slips of grassy marsh, but no extensive swamps. Perma-

* Fremont's First Report, p. 182, 183.

nent springs are numerous. The rocks beneath are Silurian limestone. The Baptist Mission buildings were erected on a prairie; but in 1844, when I was there, a grove of various kinds of forest trees had sprung up; apparently from the annual burning of the grass having been prevented. The number of benevolent white persons, of both sexes, attached to the two establishments which have been named, and a third under the management of the Society of Friends, has for several years been sufficient to test the autumnal salubrity of this locality; which is decidedly healthier than the bluffs at the mouth of the Kansas, or the prairies of Saline County; the former comparison showing the insalubrious influence of the river, and the latter announcing the great fact that, as we proceed westwardly on the prairies, autumnal fever becomes less and less prevalent.

XII. Fort Leavenworth.— This post stands on a high limestone bluff, on the right hand side of the river, four hundred miles from its mouth, in Lat. 39° 22′ 40″ N., and Lon. 94° 44′ W. The low water-surface of the river is seven hundred and forty-six feet above the Gulf; * the summit of the hill on which the fort is erected, is about nine hundred feet. The river, flowing nearly south, dashes strongly against the rocks at the base of this hill. Half-way up, there breaks out a copious spring of water, the temperature of which I found to be fifty-four degrees, Fahrenheit, in the month of August. On the opposite side of the river, there is a broad and miry bottom, with all the characteristics of those further down the river. On the same side with the fort, above and below, but not very near, there are narrower bottoms. The ground stretching off to the south from Fort Leavenworth, inclines a little, and becomes undulatory. It presents both prairie and wood-land, the former greatly predominating, and becoming still more predominant as we advance westwardly. In different directions not far from the fort, I observed small tracts of grassy swamp. While this was a new post the prevalence of autumnal fever was much greater than at present, although the condition of the low bottom on the opposite side of the Missouri has not been materially changed; which shows that a part, at least, of the early sickness was owing to topographical conditions nearer the site of the fort, which have been obviated. As the dragoons stationed here often spent a portion of the summer and autumn in excursions on the prairies, the returns do not admit of an accurate estimate of the ratios of intermittent and remittent fevers.

XIII. Settlements North of the Missouri River.— These settlements belong either to the state of Missouri, which extends up to the latitude of forty degrees thirty minutes, or to the southern or south-eastern part of Iowa, which rests upon that parallel. The former were made first; but all are comparatively new. The principal river of this region,

* Nicollet: Hydrograph. Basin.

belonging chiefly to Iowa, is the Des Moines, which originates on the Coteau des Prairies, between the St. Peter's and the Missouri, and flows nearly to the south-east, until it reaches the Mississippi.

Within the state of Missouri the population of this region is chiefly found in the little basins of Salt River, which flows into the Mississippi, and of the Chariton, the Grand, and the Little Platte Rivers, which empty into the Missouri. Of this region, I can say but little. It presents a mixture of wood-land and prairie, the latter increasing as we advance from the Missouri or Mississippi; the surface is either flat or undulating; the rivers have wide bottoms; and intermittent and remittent fevers are annual epidemics. When describing Boonville, some account was given of Howard County lying within this region.

The principal rivers of south-eastern Iowa (after the Des Moines) are the Shikagua, Iowa, Wabezipimkau, and Makokety. As far as is known to me, the country through which they flow, is in the main similar to northern Missouri, with less autumnal fever, because in higher latitudes.

XIV. The Great Plains—The Indian Country.—If the reader will turn to the map of the Interior Valley (*Pl. I*), he may, by the descriptions in this chapter, trace the boundary line of the Caucasian and Indian populations. To do this, he must descend from Santa Fé, in N. Lat. 35° 41′ and W. Lon. 106°, keeping on the east side of the Rio del Norte, until he comes to the back settlements of Texas, about latitude thirty-three; then turn eastwardly to the state of Arkansas; then ascend on the ninety-fourth meridian to the mouth of the Kansas; then go up the Missouri River to the northern boundary of the state of Missouri, in Lat. 40° 30′; and then travel north north-east to the junction of the St. Peter's with the Mississippi, in N. Lat. 44° 52′ 46″ and W. Lon. 93° 4′ 54″. In following such a line, he will have a Europo-American population to his right, and an Indian population to his left. Having done this, and cast his eyes on the Appalachian Mountains to the east and the Rocky Mountains to the west, he will at once perceive the vastness of the savannas which are still in the joint occupancy of migratory herds of buffaloes, and the savage tribes which follow on their trails. The natural characteristics of this boundless region may (as far as etiology is interested) be sketched in a few sentences. It extends through fifteen degrees of latitude; rises regularly from south-east to north-west until it reaches the base of the Rocky Mountains; has but little forest, except along its streams; consists, at and near its surface, of sand and other loose matters, which largely imbibe its rivers; enjoys but little rain, compared with the more eastern part of the Valley; from the dryness of the surface and the absence of trees, often becomes greatly heated in summer; from its declivity, its destitution of forest, and its contiguity to the Rocky Mountains, experiences unwonted coldness in winter; and finally, suffers extensive running fires, when its grass has dried in autumn.

Such a region, except near the rivers which traverse its lower latitudes, can never be much infested with intermittent and remittent fevers; but it may be scourged with the phlegmasiæ of the lungs and joints. Its summer health is likely to be greater than its winter.

XV. Journeys of Health on the Great Plains.—There are three routes by which invalids may traverse the plains.

First. The Missouri Route.—The Missouri is the only river of the entire region that will admit of steamboat navigation. The opportunity for making a distant voyage on this river does not often occur, and when it does, it should not be preferred to the others, by any who have health and strength to travel by land. The voyage, when made, is always for the purposes of trade, and is sometimes limited to the Council Bluffs, the site of the vacated Fort Calhoun, eight hundred miles from St. Louis; at others, extended to Fort Pierre Chouteau, a fur-trading establishment, five hundred miles further, above the forty-fourth degree of north latitude, and at a low-water river-elevation of fourteen hundred and fifty-six feet over the Gulf, or nearly eleven hundred feet above the Mississippi at St. Louis. Such changes of latitude and elevation must necessarily give a pleasant and invigorating summer climate to southern invalids, the effects of which will be hightened by the novelty and wildness of the scenery. The slow progress of the boat against the rapid current of the Missouri in ascending, and the frequent obstacles and stoppages, should be regarded as recommendations, and not objections, to the voyage; as they would afford opportunities for exercise or amusement on shore.

Second. The over-land route to Oregon.—This road leaves the Missouri at or below the mouth of the Kansas; ascends the valley of that river for some distance; then turns north of west to the Nebraska or Big Platte, and, traversing the Black Hills, makes its way to the South Pass of the Rocky Mountains. In making a summer journey on this route, as there is not much northing, and very limited forests, the heat may be oppressive, until a high altitude is attained; but fevers need not be apprehended. After passing the hundredth meridian, the dews are so inconsiderable, that but little inconvenience is felt from lodging on the grass, even without a tent. Excursions of health, science, and pleasure united, might be made by parties, to the distance of several hundred miles; where, in the voiceless solitudes of the desert, they might pitch their tents, and plunge into rustication. Invalids, moreover, might attach themselves to companies of emigrants bound for Oregon or Upper California; returning home as opportunities might offer. In such journeys they would find that radically curative and reïnvigorating influence which short excursions cannot, of course, impart.

Third. The route to Santa Fé.—Of the three routes this is, and for a long time will continue to be, the most traveled. Bearing a little to the south of west, it does not give the advantage of as cool a climate as the others; but the surface which is traveled over does not generate autumnal fevers. Moreover, this route may be pursued at a later period in autumn than either of the others. Another recommendation is, that the distance is not so great as that to Oregon; and yet, after reaching Santa Fé, he has it in his power to prolong his journey, by descending the valley of the Rio del Norte to the luscious vineyards of the El Paso; or he may ascend to the rich and beautiful valley of Taos; and thence scale the surrounding outliers of the Rocky Mountains. His elevation, while sojourning in these valleys, will be from five to seven thousand feet above the Gulf — quite equal to that of the *Tierras Templadas*, or temperate countries of Mexico; in addition to which, the snowy summits of the neighboring mountains will often refresh him with cool and strength-giving breezes of pure air.

From a deep conviction of the value of these overland journeys to several classes of valetudinarians, I am constrained to point out some of the various modes in which they operate: 1. The patient escapes from that malaria, or that condition of the atmosphere, which, in the larger portions of the Great Valley, gives origin to intermittent and remittent fevers, too often followed by infirmities for which a change of locality is the only effectual remedy. 2. He is constantly immersed in a dryer air. 3. He lodges on a hard bed. 4. He lives on a reduced, solid, and simple diet. 5. He drinks water. 6. He takes regular saddle exercise, or relieves himself by walking. 7. His eye and mind are constantly exercised, on objects which stand in contrast with those he has left behind. 8. He is divested of his old cares; and his new ones, although constant realities, are few in number. 9. He is redeemed from the dominion of empiricism and polypharmacy. Such are the therapeutics of these journeys; and to what infirmities are they applicable? Every enlightened physician will answer: 1. To all forms of dyspepsia, even that depending on chronic gastritis. 2. To chronic disorders of the liver, spleen, and bowels. 3. To morbid sensibility and morbid imagination, — including every shade of hysteria and hypochondriasis. 4. To apoplexy in its incipiently-forming stage, and to lingering and partial palsies, following its attack. 5. To hæmoptysis, depending on plethora or hæmorrhagic diathesis. 6. To tubercular consumption in every stage, from the earliest predisposition to that in which the patient has merely the ability to keep in his saddle through the day.

But it may be said, these journeys abound in exposures, fatigues, and privations. Undoubtedly they do; and it is on them that the benefit chiefly depends. Take them away, and a journey over the desert to the Rocky Mountains would be scarcely more efficacious than the fashionable voyage to Europe.

CHAPTER VIII.

THE SOUTHERN BASIN, CONTINUED.

MEDICAL TOPOGRAPHY OF THE REGIONS EAST OF THE GULF AND THE MISSISSIPPI, AND SOUTH OF THE OHIO BASIN.

SECTION I.

GEOGRAPHICAL AND GEOLOGICAL OUTLINES.

I. Limits.—The region on which we now enter, comprises the western side of Florida, the western margin of Georgia, nearly the whole of Alabama, a portion of East Louisiana, the entire state of Mississippi, and the west end of Tennessee. It is in fact a large section of the Great Valley, and presents to the medical topographer subjects of the gravest interest.

II. Hill Country—Old Geological Formations.— The north-eastern portions of this region, in Georgia, Alabama, and Mississippi, are mountainous or hilly, being the extreme southern termination of the Appalachian chain, turned westwardly toward the Mississippi River. From these highlands, streams pour down to the Tennessee River, to be discharged, by a circuitous course, into the Ohio, while others, larger and more numerous, flow directly to the Gulf. That portion of this water-shed which lies within the state of Georgia and the adjoining eastern side of Alabama, is composed of primitive rocks; while further west, through the latter state, into Mississippi, the rock formations consist of the older secondary or Silurian limestones, and of the sandstones and shales which belong to the superincumbent coal formation. On the Coosa River, as far down as Wetumpka, primitive rocks, in the form of gneiss and mica slate, show themselves; and at Tuscaloosa, the late capital of Alabama, on the Tuscaloosa or Black Warrior River, and on the Catawba, above Centreville, coal makes its appearance at the surface.

III. The Cretaceous Formation.— Immediately south and west of these formations, and sweeping round from Georgia to West Tennessee, we have the larger portion of the most extensive cretaceous formation which exists anywhere (as far as we yet know) in the Great Valley, or indeed on the continent of North America. The western portion of this formation, lying beyond the Mississippi River, and traversed by the Washita and Arkansas, has been already noticed. The Mississippi cuts through this formation (which constitutes its bluffs), from the western extremity of Kentucky, to a line not far above Vicksburg in the state of Mississippi. In addition to the Mississippi, it is traversed by the Yazoo and Big Black, tributaries of that river; and further east, by Pearl River, the Tombeckbee, Tuscaloosa, Cahawba, Coosa, Tallapoosa, Chattahoochee, and Flint Rivers, the last two of which, by their union, form the Appalachicola. As the strata of the cretaceous formation dip to the south, these various rivers traverse them at right angles to their lines of bearing. The general surface of this cretaceous formation, near its northern margin, is hilly; further south, and in the neighborhood of the rivers, it is somewhat rugged, with extensive intervening plains, or table lands, from which the water, in many places, runs off with difficulty; and hence sluggish and swampy streams are not uncommon. As the strata are soft, the rivers, both small and large, have formed wide valleys, most of which are subject to inundation. Although the rocks, geologically speaking, belong to the cretaceous formation, no chalk has yet been discovered. The chief deposits are calcareous, and called by the people 'rotten limestone.' They consist of an argillaceous, friable carbonate of lime; but there are, likewise, soft sandstone, and strata of clay, sand, and gravel, of which some details may be given hereafter. Where the last two are at the surface, the rains percolate into the earth, and form permanent springs of pure, soft water; but where the rotten limestone shows itself at the surface, as it is free from fissures, and impervious to water, the springs are few, superficial, and transient.

Beginning at the east, the principal towns in the cretaceous formation are, Columbus, Georgia, on the left bank of the Chattahoochee River; Montgomery, the new capital of Alabama; Wetumpka, Selma, Cahawba, Marion, Greensboro, Demopolis, Eutaw, Tuscaloosa, and Pickensville, in Alabama; Columbus, Yazoo, Pontotoc, and Holly Springs, in Mississippi; and Memphis, Randolph, Somerville, and Bolivar, in Tennessee. The whole of the cretaceous formation is infested with autumnal fever, beyond, perhaps, any other portion of the Great Valley; but yellow fever has only occurred at Memphis, on the Mississippi River.

IV. THE TERTIARY, POST-TERTIARY, DILUVIAL, AND ALLUVIAL DEPOSITS. — Advancing southerly from the cretaceous formation, we come upon the newer deposits, which extend to the Gulf of Mexico, where we have already contemplated their southern margin. These strata, which constitute the newest geological beds, are still less consolidated than the cretaceous, on which they repose. The eocene, or oldest, crop out with a line of bearing from the Chattahoochee River, to, or beyond, the Tombeckbee, and form the high bluffs of the Alabama River, at Claiborne.* This formation, which has no great width, is calcareous, and, like its mineral analogues of the cretaceous group, has a dip to the south or south south-west. To this suc-

* Conrad.

ceed the newer tertiary and post-tertiary deposits of loam, gravel, and sand, not yet consolidated into rock. As a general fact, the surface of the tertiary region, from Florida round to the Mississippi River, is flatter, and lies at a lower level, than the cretaceous. Its fertility is less, and its inhabitants fewer, but most of it is better watered. The same rivers traverse both regions, acquiring broader alluvial bottoms as they flow on to the Gulf. Much of this extensive plateau has a dry and sandy surface; but, on the other hand, much of it near the streams is swampy. Its principal towns, off the Gulf coast, are Tallahassee, in Middle Florida; Claiborne, in Alabama; Jackson, Vicksburg, and Natchez, in Mississippi; and Baton Rouge, the capital of Louisiana.

Like the cretaceous formation, all the fertile parts of this region are subject to autumnal fever of a violent character; and, as we have seen, the towns on the Mississippi have been often visited by yellow fever. The most populous portions of the cretaceous and tertiary regions here sketched out, lie between the parallels of thirty-one and thirty-three degrees north.

SECTION II.

THE COUNTRY EAST AND SOUTH OF APPALACHICOLA BAY AND RIVER.

I. General Views.—We are indebted to the Army Surgeons and Topographical Engineers who served in this region during the Seminole war, for most that we know of its medical topography, as the greater part of it is uninhabited, or but thinly peopled.* When at Pensacola in 1843, I could not obtain facilities for visiting it. The low water-shed which divides the streams that flow into the Gulf of Mexico, from those which make their way, eastwardly, into the Atlantic Ocean, subsides entirely before it reaches the twenty-eighth degree of latitude; that is, about the middle of the peninsula. Thence to Cape Sable the surface is but little elevated above the sea, and has no particular inclination. Consequently, it is overspread by savannas, swamps, immense grassy ponds, and small lakes, to a degree that must forever render most of it uninhabitable. It is called the Everglades. Above the twenty-eighth parallel, where the water-shed emerges from the dead level, the map discloses, that the number of lakes on its eastern side is much greater than on its western, or that portion which lies within the Mexican Basin, and is traversed by the Hillsboro, Withlacoochee, Santa Fé, Suwanee, and some smaller rivers. According to Doctor Forry:

"This northern portion is an extensive pine forest, interspersed with ponds, swamps, low savannas, and hummocks, which last are rich bottoms overgrown

* Medical Statistics U. S. Army.—Forry on the Climate of the United States.—Map of the Seat of War in Florida, by Captain Mackay and Lieutenant Blake, United States Topographical Engineers.

with trees, and a redundant under-wood. The barrens are covered with forests of pine, with little under-growth. The soil consists mostly of sand; but the hummocks, which are numerous, have a fertile soil composed of clay and sand. The savannas, which are covered with a tall grass, are inundated during the wet season. The river swamps are wooded with a variety of heavy trees, whilst the pine-barren swamps are mostly overgrown with cypress and cypress-knees."*

The dry pine lands are composed mostly of silicious sand, more or less fertilized with carbonate of lime and vegetable mold. The swamps on the borders of the rivers are formed by the inundations, which deposit alluvion on their banks, and thus dam out a portion of the returning waters.

The sub-stratum of this region, and of the peninsula of Florida generally, is rotten limestone — cretaceous or tertiary; but it differs from that of Alabama, in being cavernous; and hence many of the smaller streams disappear from the surface, and reäppear in the form of copious springs. Small lakes, likewise, occasionally empty themselves through unseen fissures in their beds; and many of the tracts denominated hummocks seem to have been laid bare in this manner. We must now take notice of some localities.

II. Fort King.— The site of this military post is not positively within the Mexican Basin, for the copious spring of pure water which originates near it, flows to the east. There are reasons, however, for claiming it as belonging to that basin, and no valid geographical objection, seeing that it stands on the dividing ridge which makes the eastern boundary of the basin.

"As regards geographical position, this station is about ninety-five miles north-east of the head of Tampa Bay, one hundred and thirty south-west of St. Augustine, perhaps forty miles due east from the Gulf of Mexico, and sixty due west from the Atlantic Ocean. The fort, which has been recently rebuilt, is situated on rising ground, partially encompassed by a hummock, which describes almost a semi-circle, at an average distance of five hundred yards from the pickets. The surface of the surrounding country is slightly undulating. The soil of the so-called *pine barren* consists of loose sand and a light admixture of vegetable mold, with an argillaceous sub-stratum. Its principal vegetable productions are, the pitch pine (*Pinus rigida*), black jack (*Quercus nigra*), scrub oak (*Quercus catesbæi*), palmetto (*Chamærops*), and coarse herbaceous plants. The *hummocks* are rich, marshy bottoms, composed of vegetable deposition, overgrown with redundant vegetation. Here flourish the live-oak, with other species of the same genus, the cypress, magnolia, cabbage-tree, and several varieties of hickory (*Carya*), all united by a cordage of vines and brambles, extending from trunk to trunk and from limb to limb, constituting an immense net-work of vegetation.

"No large bodies of water exist in the vicinity of this post. Three miles

* Climate of the United States, p. 193.

from this point is Silver Spring, the source of a beautiful stream of the same name. From this fountain, remarkable for its transparency, Silver Creek emerges at once a bold stream, sixty yards wide and twenty feet deep, running into the Ocklewaha about twelve miles from this post.

"Although large bodies of water do not exist in the vicinity, yet the actual quantity is very great, owing to the extensive marshy low-lands, swamps, and stagnant pools; and as the soil is not completely covered with water, the circumstances most conducive to the evolution of those morbific agents resulting from solar influence, obtain. The humidity of the vicinal *hummocks* gives rise to constant exhalations, which fall in heavy dews."*

The annual ratio of intermittent fever at this post, as deduced from the returns of four years, is one hundred and twenty-three per cent.; of remittent, twenty. These ratios are decidedly high.

"This post, however, has always been regarded as decidedly salubrious, with the exception of the liability to fever and ague. Violent fevers of the remittent form, and intermittents running into the same type, occurred in the latter part of the summer of 1837, owing, doubtless, to the circumstance that the smaller trees and under-growth of a neighboring *hummock* had been cut down, as a precaution against Indian ambuscade. It is a well-known fact that military stations, near jungles, often continue healthy until the soil is brought under cultivation, or the trees and shrubbery cut down, exposing the boggy surface to the agency of solar action."†

When adequate settlements shall be made at Fort King, it will perhaps become an important place of winter resort for invalids. Lying nearly a degree south of St. Augustine, and more than a degree south of Pensacola, it must have a warmer winter climate than either; and being nearly equidistant from the Atlantic Ocean and the Gulf of Mexico, on the shores of which those resorts for invalids are, respectively, situated, it has an equal advantage as to diminution of atmospheric moisture and the absence of a mixture of land and sea airs.

III. Except Fort Brooke and Fort King, nearly all the posts of Florida were temporary, and their topography has not been published. I can give the following memorandums of two or three others, from conversation with Assistant Surgeon Holmes, who served at each of them.

1. *Fort Wacasassa.*—This post was situated about thirty miles from the Gulf, on the head waters of a small river which enters it between the Withlacoochee and Suwanee. Its site was the edge of a wet prairie, and yet it was regarded as one of the healthiest posts in Florida.

2. *Fort White* was erected on the left bank of the Santa Fé River, about eighteen miles from its junction with the Suwanee. On the opposite side of the river (which is forty yards wide) there is a cypress swamp. The

* Climate of the United States, pp. 212–13. † Med. Stat. U. S. A., p. 295.

rocks beneath are rotten limestone, with good springs. Autumnal fever, in all its varieties, was common.

3. *Fort McComb.*— The Suwanee River, one of the largest in Florida, has its origin in the vast Okefinokee swamp, extending from the thirty-first to the thirty-second degree of north latitude. On its way to the Gulf it is joined by the Santa Fé, just mentioned, below which its wide, swampy bottoms are overshadowed by moss-hung cypress trees, loftier than Doctor Holmes saw anywhere else in Florida. Fort McComb is situated on the right side of this river, a considerable distance from the Gulf, about Lat. 30° N. The banks are rocky and sandy; the surface of the plain is white sand, with a sub-stratum of clay a foot beneath. There are no swamps nor drowned lands near this post; yet it is infested with autumnal fever.

SECTION III.

BASIN OF THE APPALACHICOLA RIVER.

I. The River.— This considerable river extends from the southern bend of the Appalachian Mountains, directly south to the Gulf of Mexico. It is the most eastern river of this part of the Great Valley. Its upper portion, under the name of Chattahoochee, flows through the primitive formations,— its lower half traverses the cretaceous and tertiary. It drains the western part of Georgia, the eastern of Alabama, and, to some extent, the northern of Florida.

II. Fort Mitchell.— This, now ungarrisoned, post was situated ten miles below the town of Columbus, on the right or west bank of the Chattahoochee River, in N. Lat. 32° 19′ and W. Lon. 85° 10′. It occupies an elevated ridge about one mile from the river. Between it and the river the bottom is low, but nearly free from marshes. In reference to autumnal fever, it was found remarkably salubrious; the annual ratio of intermittents being only thirteen per cent.; of remittents, eight per cent.*

III. Columbus.— I am indebted to Doctor Charles A. Hentz, for a description of the medical topography of this place. It stands on the left or eastern bank of the Chattahoochee River, which, for a long distance, makes the dividing line between Georgia and Alabama, in N. Lat. (about) 32° 25′, and W. Lon. near 85° 10′. Geologically, it is found at the junction of the cretaceous formation with the primitive. Opposite to, and above, the upper or northern part of the town, there are rapids, and the river-bed abounds in masses of granite and other primitive rocks, which are more or less grouped into small islands. In some places these rocks have become decomposed into beds of kaolin, out of which a dentist of the town, by the aid of his blow-

* Medical Stat. U. S. A.

pipe, has made artificial teeth. The rapids at this place render a higher ascent of the river by steamboats impracticable. Within a mile of their foot, there are two mill-dams; but the declivity on which they stand prevents the formation of extensive ponds. No portion of the river-bottom on either side is subject to inundation. "The town-site is a smooth plain, elevated about fifty feet above the surface of the river, that elevation being reached by two ascents;—the first bluff is thirty feet high, with a plain five hundred feet in breadth, in its rear;—the second bluff is twenty feet higher, and spreads out into the margin a much broader terrace, on which the town is chiefly built. The two terraces are a mile in breadth. Then comes a third rise of about one hundred feet, to a plateau a mile broad, beyond which there is a creek, with low, marshy bottoms, appropriated to the growing of rice."

The gutters of the second terrace discharge their waters into an artificial drain, with which some rivulets, originating near the north-east corner of the town, have been united. The depression of the plain through which this drainage takes place, presents sloughs and ponds, some of which are dried up in summer. A little further to the east, is a larger stream, with tracts of wood-land swamp. These bad topographical conditions happily lie to the leeward of the town; but on the opposite or western side of the river, there are sources of autumnal fever which lie to the windward. On that bank we have the village of Girard, through which Marshall's Creek makes its way to the Chattahoochee. Within the village it is extremely tortuous; at the distance of one and two miles from its mouth, there are two mill-dams with foul ponds; and immediately below the first, there is a belt of alluvial marsh. The inhabitants drink water, introduced by a hydrant system, from a neighboring spring. Autumnal fever is the chief object of medical practice in Columbus. It prevails most in the south-east part of the city, in the neighborhood of the drain, and of the wet or pondy tract through which it runs. The fever displays every type and grade of violence. On the Alabama side, along the high banks of Marshall's Creek, its prevalence is still more certain and dangerous. Yellow fever has not occurred in this locality.

SECTION IV.

BASIN OF THE ALABAMA RIVER.

I. The River.—It has been already stated that this river is composed of the Coosa and Tallapoosa, which, after their junction, assume a common name. As it descends to the south, it is reïnforced, through its right bank, by the Cahawba; but the number of its tributaries is small. Before reaching the head of Mobile Bay it unites with the Tombeckbee, and assumes the name of Mobile River. Here commences the long estuary—briefly described on page 54—which extends down to the city of Mobile. The settlements along this estuary are comparatively few, and they are infested with severe autumnal fevers. Near its termination in the bay, on the left-hand side, is the blighted village of Blakely, which has suffered, once or oftener, from yellow fever. That disease, however, has not, I believe, yet advanced further up the estuary.

After leaving the highlands, the Alabama River flows through loose cretaceous and tertiary strata, in which it could not fail to excavate a wide valley. Its banks become more developed as we advance upward. Like other streams which meander in alluvial valleys, it generally presents a bluff on one side, and a low bottom, subject to annual inundation, on the other. In many places the bottom is from two to three miles wide; and, where not subjected to cultivation, presents forests of cane, cypress, sweet-gum, sycamore, cotton-wood, magnolia, and live-oak, with an iron-gray drapery of long moss. The face of the bluffs is generally wooded with the same trees, except the cypress. On their summits the forest becomes piny. These summits, in the form of plateaus, stretch off from the river, indefinitely, on both sides, and abound in swamps, the tree and herbaceous vegetation of which is not unlike that of the bottoms, while the dryer and sandier portions are overshadowed with interspersed pines and oaks.

As the river, descending from the north, strikes against the out-cropping edges of the strata, through which it cuts at right angles to their line of bearing, the medical geologist, on the upward voyage, has an opportunity of becoming acquainted with the mineral character of the superficial parts of the region which he traverses. At first, he sees beds of tertiary clay and loam, which present shades of blue, red, and yellow; then comes, at Claiborne, the bold out-crop of old or eocene tertiary limestone, more solid, and, therefore, less disposed to crumble away, than the looser strata which overlie it; to the limestone succeed, as we advance, beds of sand, loam, gravel, lignite, and shale, inclosing geodes, which are arranged in strata. Further up, are new and much thicker deposits of loose reddish clay and sand; then follow high banks of coarse friable rocks, sand, dull red and blue clays, and rolled pebbles, consolidated into breccia or pudding-stone, the stratification being waved, oblique, and extremely irregular, but on the whole affecting a horizontal position. In low situations, a soft, bluish, cretaceous limestone now shows itself, and the surface of the country becomes more rugged. In this enumeration, no reference is made to the line of division between the tertiary and cretaceous groups of the geologists, which are characterized by different organic remains; nor is it necessary, for the medical etiologist is only interested in the mineral constitution of the rocks which underlie or constitute the surfaces which he studies.

But little of the bottom-land of the Alabama River has been reclaimed; and much of it is subject to such deep inundations that its cultivation is impracticable. It would seem scarcely necessary to say, that the inhabitants near such a stream, in the latitudes of thirty-two and thirty-three degrees north, are subject to the worst forms of autumnal fever. Those who reside at the water's edge, with a swamp between them and the distant bluffs, are said to be less liable than those who live on the bluffs; but the population visible from the river is sparse; for experience has shown the necessity of placing families in the pine woods, at the distance of one, two, or three miles from the river.

But few towns of any considerable size adorn the banks of Alabama River. Those which I am about to describe are the most important, and their topography will serve, in some degree, to fill up the meager outline which has been sketched.

II. CLAIBORNE.—This was originally a military post. It is situated on a very high bluff, on the left side of Alabama River, not far above its junction with the Tombeckbee, in N. Lat. 31° 30′. It stands on the eocene or oldest tertiary calcareous rock. According to Doctor Lewis, the plain inclines back from the brow of the bluff until it terminates in a few low marshy ponds.* On the opposite side of the river, there is a depressed and swampy bottom. Claiborne is subject to severe autumnal fevers of every form and grade; but has not, I believe, suffered from yellow fever.

III. CAHAWBA: RIVER AND TOWN. *The River.*—It has been already mentioned, that Cahawba River is the largest tributary of the Alabama. Its origin is in the highlands, between the Coosa and Tuscaloosa, whence it descends into the cretaceous formation, within which it has wide bottoms, subject to annual inundation. It joins itself to the Alabama, while still in that formation, a little above the thirty-second degree of north latitude. Immediately below its junction, which is through the right or west bank of that river, stands

The Town.—In 1831, the late respectable Doctor Heustis published an instructive paper on this locality,† and in 1843, I paid it a short visit. The plain on which the town is built consists of red and yellow loam, sand, and pebbles, which repose on strata of bluish rotten or cretaceous limestone or marlite, which shows itself in the river bank, between high and low water-marks. The elevation of the site is not such as to preserve it from inundation when the river rises to its greatest hight; and at such times the grounds above the mouth of Cahawba River are likewise overflowed. On several parts of it there were ponds, which have been drained. To its north-west, extending from one river to the other, there is, as Doctor English and Doctor Morrell informed me, a liquidambar swamp, about a mile and a half in width, the margin of which is three miles from town. On the opposite side of the Alabama River, to the east, the plain is elevated and sandy, but includes a few ponds. Cahawba is the seat of justice of Dallas county, concerning which Doctor Heustis, in the paper referred to, speaks as follows:

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* New Orleans Journal, Vol. III, No. 6.

† American Journal, May, 1831, p. 75.

"There is in this county a very considerable proportion of fertile land, confined principally to the rivers, creeks, and prairies. The upland in other situations is generally thin and sandy, yet when of moderate fertility, it is often preferred, on account of the purity of the water and healthfulness of situation, to the less salubrious though more productive lands near the rivers. Perhaps there is no country possessing a greater variety of soil, and in which sudden changes take place more frequently from fertile to poor, and *vice versa;* or, in common parlance, where the land is more spotted: not unfrequently a space or strip of a few yards constituting the boundary between lands of very poor and of very rich quality. It would seem that, with the exception of the more recently formed rich river-lands, this great and sudden variation in the soil is owing, in a considerable degree, to the depth or proximity to the surface of the subjacent limestone. There can be little doubt that this limestone possesses the property of great fertility.

"The land, not only of this county but also of most others in the state, may be divided into six natural varieties, or classes. First, the side river-bottoms, or swamps, as they are called, subject to inundations. Second, the more elevated river-lands, of inferior quality, and not subject to overflow. Third, hummock, or second river and creek-bottom, or low grounds of a loose, black, sandy soil, fertile, and above inundation. Fourth, first quality of upland, of intermediate fertility between the hummock and second quality of upland. Fifth, second quality of upland, consisting principally of piny woods, interspersed with a few oaks, hickories, &c. Sixth, prairie. The extent of the first division, or river-bottom, is extremely various and irregular, being sometimes a mere border, of not more than forty or fifty yards in width, and in other places extending from one to two miles from the river; and in other situations again, the second quality of upland or piny woods, reaches to the very river, forming high and precipitous bluffs. Generally, where one bank of the river or creek is formed in this manner, the opposite one is low, with a greater or less extent of rich river or creek-bottom. Before, and at the first settlement of this country by the present white population, the rich river-lands were thickly covered with gigantic cane; this, since that time, has, in many places, been entirely destroyed by accidental fires, and by cattle, which are extremely fond of it, especially when young and succulent, at which time they eagerly devour the whole plant. Thus, when the old cane dies, as it does spontaneously in a few years, after going to seed, as none of younger growth has been left to succeed, the crop is entirely destroyed. There is, however, in this state, a considerable proportion of cane land remote from the rivers and creeks. It is scarcely necessary to say, that land of this description is of the first quality. When the growth of cane is not situated on the rivers and creeks, or, in other words, where the soil which produces it is not *made land*, the result of alluvion and inundation, it is of prairie or limestone quality."

Both Cahawba and the surrounding country have, from the beginning of their settlement, been subject to violent and often fatal intermittent and remittent fevers; but, with the progress of cultivation, the severity of these diseases has been considerably mitigated.

IV. MARION.—We must diverge from the bed of the Alabama River, to say something of a town situated on the waters of the Cahawba. Marion is the principal town of Perry county, which adjoins Dallas county on the north. The streams which originate around it, flow partly into the Cahawba, and in part into the Tuscaloosa. Its site is uneven, and the ground slopes in all directions from it. The general surface of the country around it is dry and moderately fertile, with scattering pines. Sloughs and marshes are few in number, and the streams flow with greater velocity than in many other parts of South Alabama. The surface, much of which presents reddish, sandy loam, is undulating. From the best information I could obtain, the autumnal health of Marion is in harmony with its favorable topography. Mr. Jewett, the teacher of one of the female academies, with his assistants, averaging seven persons in the family, all from the north, had resided here four years, without one attack of autumnal fever.

V. SELMA.—The position of this town is ten miles above Cahawba, on the right bank of Alabama River. Its site is an elevated sandy plain, presenting bluffs, washed by the river; which, on reaching the town, has flowed from the south-east, to bend soon afterwards to the south-west. The plain, covered with oaks and scattering pines, is free from ponds and marshes. To the north and east of the town, however, at the distance of two or three miles, there is an extensive swamp. Soft and good water is obtained on the town plat, by digging twenty or thirty feet. From a comparison of all the information I could collect, at this place and Cahawba, concerning autumnal fever, I am brought to the conclusion, that the disease prevails less here than there; which might be expected from the differences in their topography. It has not been visited by yellow fever.

In a late paper by Doctor Harris, on the Medical Topography of South Alabama, I find the following paragraph:

"In 1824, the yellow fever appeared in Selma, and that section of the country known as the Pleasant Valley, ten or twelve miles north; one case under Doctor Phillips terminated fatally on the third day after black vomit, and several cases under my inspection on the fifth and seventh days after the same, some in collapse. There was no yellow fever in Mobile at the time."*

It is remarkable that Doctor Heustis, in his paper on the Diseases of Cahawba, is silent as to this alleged yellow fever; and that Doctor Lewis, in his Medical History of Alabama, has not adverted to it; and equally remarkable that, in the course of a rigid inquiry, in 1843, into the fevers of that region, not one of its numerous physicians should have mentioned to me

* West. Jour. of Med. and Sur., (Louisville), December, 1846.

what Doctor Harris has since published. In the history of our yellow fever, this statement will again come under review.

VI. Montgomery.—This city has lately been made the permanent capital of the state of Alabama; and being both the most populous, and the largest cotton-shipping town of the interior of the state, it merits a more extended notice than has been bestowed upon Selma. The position of Montgomery, on the left bank of Alabama River, four hundred miles from Mobile, in N. Lat. 32° 10′ and W. Lon. 86° 12′, is on the convexity of a compressed horseshoe bend. Thus, in approaching the city, the river flows *from* the north north-west, and, in departing, flows *to* the north-west; folding on itself in a remarkable manner, and forming, opposite to, and north-west of, the city, a low, long, heavily-timbered peninsula, which is too liable to deep inundations to be cultivated, except in a few spots.

The immediate site of the city is a terrace, above high water-mark, with an amphitheatre of hill-land, or bluff, more than one hundred feet high, in its rear, and extending from the east round to south-west. The surface of the plain on which the city is chiefly built, is sandy; and, at the beginning of its settlement, had some ponds, which have been since filled up. The streets are unpaved, and but indifferently shaded. On the plain to the north-east of the city, there are numerous ponds and marshes, which are thrown into forms more or less elongated and serpentine, by oak and pine ridges or narrow plateaus, which gradually become more elevated and hill-like, but still embosom stagnant and swampy streams. The upper stratum of this tract is a red, sandy loam, with beds of silicious gravel. To the west north-west of the city, there is a margin of lower and wetter bottom-land, on the upper end of which attempts were once made to build a town, but it proved too insalubrious. In the rear of this bottom, a plateau, as elevated as the site of the city, begins, and stretches westwardly to the junction of Catoma Creek with the river, eight or ten miles below. The predominant growth of this plain is oak. It abounds in ponds and marshes. After ascending the hills south of the city, a long descent to the south very soon begins, and continues to Catoma Creek, which is found to the south-east, south, and south-west of the city, at distances varying from three to nine miles. The valley of this stream is from half a mile to a mile in width. Its depressed surface is generally swampy, and its tree, bush, and herbaceous vegetation, luxuriant. The sloping hills which bound it, present strata of fissile clay, and soft marlite, or rotten limestone,—which, together with the superincumbent loam and sand deposits, belong to the cretaceous formation. With such a topography, we cannot be surprised to learn, that this locality is among those which are infested with all the grades and varieties of autumnal fever; but it has never experienced an invasion of yellow fever, although the intercourse by steamboats, between it and Mobile, is of the most intimate kind.

About ten miles, by land, above the city of Montgomery, we reach the head of Alabama River, or the junction of the Tallapoosa with the Coosa.

The road, for most of the distance, passes over a plateau, which abounds in shallow ponds and stagnant streams, bordered by sloughs, and abounding in various kinds of evergreens. The descent into the valley of the Tallapoosa is by three terraces, the last of which, extending to the river's edge, is subject to deep inundation, as appears from the water-marks on the trees. Four miles from this crossing, is the town of

VII. WETUMPKA.—Its site is at the foot of the long rapids of the Coosa; which river divides it into two villages, denominated, from their position, East and West Wetumpka. The former stands upon a narrow, elevated, and rather rugged plain, with the river on its west, and a range of knobs from one to two hundred feet high, on the east, in close proximity. They are composed of a dry, gravelly, micaceous, red loam, surmounted by pines and chestnuts; and are succeeded, to the east, by still loftier hills. West Wetumpka, connected with the other village by a bridge, is built on the margin of a plain which stretches off indefinitely to the west. A slip of this plain, in front of the lower part of the town, is subject to occasional inundations. On the terrace above, in the south-western part of the village, there is a long, narrow swamp, which discharges its waters into the river below the town. The rest of the site is dry, with a sandy yet not sterile surface. On the north and north north-west, the town plat is dry, and limited by hills similar to those described as lying on the opposite side of the river. About three miles to the west, there is a stream called Mortar Creek, not large enough for mills, which represents many others on the pine plains of Alabama. It consists of a series of narrow swamps, through which there is a sluggish and interrupted current of clear water. The want of declivity lies at the root of this topographical evil. Beds of clay beneath the more sandy surface, prevent the rains from percolating into the earth, and want of fall retards their flowing off; and therefore the water diffuses itself laterally. Trees and shrubs which flourish in such localities, multiply, and when they fall, tend still further to obstruct the feeble current, and thus the marsh or superficial pond is extended. Mortar Creek, which enters the Coosa River three or four miles below Wetumpka, has many tributaries, partaking more or less of its own character, and giving to the country, to the south-west of the town, a great deal of swampy surface. Through some of these sloughs, which are separated by zones of dry wooded plateau, ditches have been dug, with the effect of draining them, and exposing a dryer and highly fertile surface. On a visit to the cotton plantation of Governor Fitzpatrick, which lies in a bend of the Coosa River, between the mouth of Mortar Creek and Wetumpka, he informed me, that much of his land had been redeemed in that manner. That part of it which lies nearest the river, gradually sinks in level, until it becomes subject to inundation. Below the town, the bottoms of the Coosa, on both sides, are, in fact, subject to overflow; and as the river there bends to the west, its alluvial grounds, not less than the swamps or swales of the plain which I have described, unfortunately lie to the south-west or windward of the town; and this accounts satisfactorily for the decided prevalence of the various forms of autumnal fever, which have visited this place since the beginning of its settlement in 1833. Steamboats from Mobile visit Wetumpka, which is at the head of navigation; but the yellow fever has not occurred.

Another fact must be mentioned to complete the medical topography of this locality. The bed of the river, at the termination of the long falls or rapids, in the upper part of the town, is composed of primitive rocks, *in situ*, having a dip of about forty-five degrees to the north or north north-west. They consist of gneiss and mica slate, which appear to be undergoing constant disintegration. The adjacent hills rest upon these rocks, and, as they abound in mica and silicious materials, may be regarded as the *debris* of the primitive formations, which, further up the river, are developed into a mountainous country, abounding in gold. Wetumpka is, in fact, seated on the last out-crop of the cretaceous formation, at its junction with the primitive. The mica, which is here liberated in large quantities, impregnates the waters of the springs and wells, in the form of an almost impalpable, foliaceous powder, which is often observed in the bottoms of the vessels, in which water is kept for drinking. To this impregnation, many of the physicians ascribe the chronic diarrhœa which, in town and country, and also in the state penitentiary, prevails to a degree quite unknown, as it would seem, in any other part of Alabama. When treating of that disease, this hypothesis will be considered.

SECTION V.

BASIN OF THE TUSCALOOSA OR BLACK WARRIOR RIVER.

I. Region between Wetumpka and Tuscaloosa.—The plain on which West Wetumpka is built, stretches off to the west, and for about thirty miles presents a dry, sandy, or clay and gravel surface, overshadowed by forests of long-leafed pine, interspersed with oaks, and having, here and there, a wooded swamp or marshy creek of very limited area. The high, blue hills, which to the north-west embosom the Coosa River, as it flows down to Wetumpka, are frequently in sight; indicating that the route lies near the northern margin of the flat country. The inhabitants on this road are but few, yet the number is sufficient to test its salubrity; and I was assured by several of them that, after leaving the wet lands near Wetumpka, autumnal fever is unknown. At the distance of thirty miles, the road turns more to the north, and encounters the hills, among which water is still scarcer than on the plain, and autumnal fever equally absent. At length the road descends into the low and wet valley of Mulberry Creek, at Maplesville, where autumnal fever abounds. Beyond this alluvial tributary of the Coosa River, a hilly and healthy country is again reached, which continues to Centreville, on the banks of the Cahawba River, where autumnal fever reäppears. A rugged surface, with oak and pine, succeeds; the inhabitants of which enjoy a complete immunity from fever. At length the surface begins to assume a lower and more level aspect, and a dark brown, friable, ferruginous and cretaceous sandstone shows itself, in connection with increasing cultivation; which amelioration continues to the town of Tuscaloosa, on the left bank of the Tuscaloosa or Black Warrior River, about one hundred miles from Wetumpka; and with this change there is some increased prevalence of the fever. This route lies nearly in the mean latitude of thirty-three degrees; and the region which it traverses, affords an instructive illustration of the connection between the surfaces of a country and its autumnal fevers.

II. Town of Tuscaloosa.— This town, the seat of the University of Alabama, and until lately the capital of the state, stands in N. Lat. about 33° 15′, on the eastern or left bank of the Tuscaloosa or Black Warrior River, at an elevation of about one hundred feet above the river. The plain is composed of red and yellow, dry, crumbling sand, gravel, and clay; which, although hard and compact at the surface, is readily undermined and washed away, forming deep ravines. From the north-west round to the south-east, the terrace is abutted by a hill country, through which the river makes its way to the plain. Here, also, is the final out-crop of the imperfectly consolidated cretaceous and tertiary strata; for coal is found but a short distance above the town, as it is also above Centreville, near the Cahawba River; indicating that a carboniferous formation here supports the cretaceous, which at Wetumpka rests upon the primitive. To the west, south-west, and south of the town of Tuscaloosa, the surface differs widely from that in the opposite directions. As it passes by the town, the course of the river is nearly south south-west, and between them there is a narrow slip of low bottom, which widens for a mile above, and then terminates. On the further side of the river, stands the village of Northford, on a wider alluvial plain, much of which is liable to inundation, when the river is swollen.

A mile or two west of this village, there is a creek called Orange, which flows sluggishly through a foul, wooded swamp, that extends to the river, below the town. On this stream there is a mill, the superintendent of which assured me, that he had been sick with fever every autumn for four years, and that nearly every one of ten operatives, employed in the establishment, had experienced an annual attack of the same kind.

After passing Tuscaloosa and its *faubourg*, Northford, the river turns to the west, which direction it maintains, as Doctor Drish informed me, for several miles, then bends to the south, and finally flows for a number of miles to the east, until meeting Sandy Creek, it again turns to the south. Thus to the south-west of Tuscaloosa, there is a great horse-shoe, or elliptical bend, broader than, but analagous to, that of the Alabama River near Montgomery. Nearly the whole of the extensive tract there inclosed, is liable to inundation when the river rises high, and much of it is overflowed in ordinary freshets. By the first of June, annually, most of the water drains off, or is evaporated; and then the cultivation of the higher parts is recommenced. These portions are, generally, in the form of long, narrow, flat ridges, between which there are permanent swamps, lagoons, and ponds, with low, foul margins, disfigured by fallen trees, and infested with venomous snakes. One of these ponds, out of which a stream flows during the whole year, has been sounded to a great depth, as Doctor Guild and Doctor Harrington informed me, without finding bottom. It is doubtless a natural Artesian well. Of the swamps, one, overshadowed by liquidambar, and by cypress with long moss, has a length of eight or ten miles, with a breadth sufficient to inclose several islands, on which there are cotton plantations. The operatives on these islands, as I learned from Doctor Drish, are exceedingly subject to autumnal fever. The whole tract, lying, as it does, to the windward of Tuscaloosa, is undoubtedly a chief cause of the fevers which prevail there; which, however, are not as malignant as those of some other localities.

To the south of the town, the plain on which it stands, although, in most parts, dry, is not free from swamps and swales, which combine their sinister influence with that of the horse-shoe bend. Traces of a swamp, which formerly existed in the southern part of the town itself, are still visible.

III. Tuscaloosa or Black Warrior River.—This river is properly a large tributary, almost a coéqual, of the Tombeckbee. Above the town it has the character of a mountain, or at least an upland stream; below, until it loses both its name and waters in the channel of the Tombeckbee, near Demopolis, it flows through a wide alluvial valley, most of which is liable to inundation when the river is swollen. At such times, steamboats ascend it to Tuscaloosa. Near Eutaw, not far from its mouth, the valley is four miles wide, and so low and flat that much of it is traversed on a causeway of logs, on each side of which there are swamps and ponds, overshadowed by a dense forest, and made foul with the decaying limbs and leaves of trees, mingled with silt from the river. I need scarcely add, that those who live on its banks, from the hill country above Tuscaloosa to its mouth, are subject to autumnal fever.

IV. Country between Tuscaloosa and Pickensville on the Tombeckbee River.—The distance between these two points is about fifty miles—the course nearly from east to west. The road keeps within the cretaceous formation, but much of the route is high and rugged. Some of the hills rise, by estimate, five or six hundred feet above the level of Tuscaloosa River; and consist of friable, earthy sandstone, with unconsolidated loam and gravel. The scattered inhabitants of this tract escape autumnal fever. The highest hills are near the Sipsey River, a considerable tributary of the Tombeckbee, which has cut itself a deep and wide valley through these loose deposits. Where the road crosses this valley, a causeway of logs continues uninterruptedly for two miles, with foul swamps on either side. In this locality I did not discover either cypress or long moss; though both are seen in the horse-shoe bend below Tuscaloosa. The latitude is about 33° 20′ N., being a little north of that of the bend referred to. West of the Sipsey, the country continues dry and rolling, but is less elevated, and, gradually declining, becomes comparatively a fertile plain, for many miles before reaching the Tombeckbee River.

SECTION VI.

LOCALITIES IN THE BASIN OF THE TOMBECKBEE.

I. Pickensville.—This village, which does not contain more than three hundred inhabitants, is seated on the western margin of the plain just described, about half a mile east of the Tombeckbee River, and within a mile of the boundary between Alabama and Mississippi. Unimportant as this place may seem, its medical topography deserves attention. The course of the Tombeckbee River, at this point, is nearly south south-east. From the north round to the south-east, lies a high and dry plateau, consisting of red and yellow gravelly-loam, cut into ravines, and thinly covered with oak and pine trees. The village stands on the margin of this plain, which, in some places, is thrown up into low hills. On descending from this terrace, through sixty or eighty feet, we come upon the river-bottom, which is subject to annual submersion, and covered with the forest trees that belong to such localities, overshadowing a rank herbaceous vegetation. In the river banks, near the water's edge, we see rotten limestone or marlite (cretaceous limestone), in strata dipping slightly to the south. On the further side of the river, we are again in a low, untilled bottom, subject to frequent overflows, and infested with pools, lagoons, and swamps. This continues to be the case for a mile and a half, when an imperceptible ascent carries us above ordinary floods, but the plain is still swampy: and the streams that meander feebly through it have marshy borders, for the distance of two or three miles; when we ascend a higher and better defined alluvial or diluvial terrace, which the river cannot reach. The surface of this old and upper bottom, is more sandy than that near the river. It bears the forest trees, including pines, which in the south belong to thin and dry soils. The width of this bottom is about two miles. Having traversed it, we make another and greater rise, through a narrow belt of woods and annual plants, common on the limestone lands of Kentucky and Ohio, six or seven degrees further north. This summit-level attained, we find ourselves on the limestone prairies, which will be described hereafter. The topographical section here given is, I believe, applicable to almost every part of the Tombeckbee River, above the mouth of the Tuscaloosa, near Demopolis, and not inapplicable to some parts below. In visits to Doctor Yongue, Doctor Swearingen, and Doctor Brown, I had favorable opportunities for inspecting the valley, which extends, longitudinally, nearly from north-west to south-east, and lies directly south-west of the town of Pickensville, and consequently to its windward. As no other recognized cause of autumnal fever exists in or near Pickensville, we must ascribe its annual visitations by that disease to this valley. One of these visitations, in 1835, almost destroyed or dispersed its inhabitants. Steamboats frequently stop at Pickensville landing, but it has not experienced yellow fever.

II. Columbus, Mississippi.—The distance from Pickensville to Columbus is about twenty-three miles. East of the Tombeckbee River, the road runs over a surface dry and somewhat broken, composed of the same materials with the plain at Pickensville; and bearing oaks and pines, as its predominant forest trees. To the east, the country rises still higher, and presents the final out-crop, in that direction, of the cretaceous formations: to the west is the broad trough of the Tombeckbee, and beyond it the prairies. The town, standing on the left or east side of the river, has for its site a long and rather narrow plain or ridge, on the east side of which is a valley, while on the west we have the Tombeckbee River. The valley opens into that of a stream called the Looksphellila, which discharges its waters into the Tombeckbee, two miles below the town, and has its own wide bottoms overflowed whenever the river is swollen. The sources of this tributary are found in broken pine and oak lands, composed of loose materials, east and north-east of the town. In summer, the waters of these heads or sources stagnate; and in their valleys there are, moreover, small lagoons and cypress swamps, which generate autumnal fever among the inhabitants, who are sufficiently remote from all other insalubrious localities. The trough of the Tombeckbee, opposite Columbus, does not differ materially from that near Pickensville, already described. The site of the town, on the river side, has a bluff bank seventy or eighty feet high, to the base of which the river makes a near approach; though immediately above, there is a wide and wet bottom between them. In traversing the bottom, west of the river, and opposite the town, we find it low and subject to inundations, which leave sloughs and lagoons behind, overshadowed with cypress, destitute of its more southern parasite, the long moss, which here does not reach the latitude of thirty-three degrees thirty minutes. Then comes a higher and cultivable terrace, not subject to inundation, but traversed by lagging streams, and bearing oaks and pines; to which succeed, as at Pickensville, the prairies. In ascending upon the prairies, we see in the banks of the rivulets, the friable or rotten cretaceous limestone, resembling that which the banks of the river at Pickensville present. The intermediate terrace, between the low alluvial bottom and the prairies or highest uplands, is inhabited; and here, as well as opposite Pickensville, it is declared to be more unhealthy than the low and wetter bottoms. The plantations on the latter are, however, too few to admit of a satisfactory comparison; while the two belts are so contiguous, and so dove-tailed into each other, that whatever cause of disease is generated on the lower, of necessity affects the people living on the upper and dryer plain. As the general course of the river here is the same as at Pickensville, its broad, alluvial, pondy, and marshy valley, unfortunately lies to the south-west or windward of the town. The following fact, which I received from Doctor Jones, seems worthy of being recorded as a part of its history.

In the summer of 1837, a field of oats, when nearly fit for the sickle, was inundated by a great rise of the river. After the flood had receded, Doctor Jones sent six negro men to cut the tangled, half-dead, and decaying crop. They lodged on the premises, in a shanty, for nearly a week, when one of them sickened with fever, and the whole were recalled. All, however, were soon afterwards taken down with intermittents or remittents, while the different families from which they had been detached, remained healthy.

In the early periods of its settlement, from 1822 to 1825, Columbus was much infested with autumnal fever, but latterly it has suffered less. Its latitude, as I have intimated, is about 33° 30′ N.

III. THE PRAIRIES.—The tract of country which is denominated 'The Prairies,' is found chiefly on the western side of the Tombeckbee River; but that stream, changing its course, at length, from south south-east to south, traverses the prairie-country; so that land of the same description is found to a considerable distance east of that river, in Greene and Marengo counties, where it gradually becomes wooded, and has received the name of 'The Cane-brakes,' from a luxuriant growth of native cane (*Miegia*). I cannot state the precise limits of this tract in the north and west. I was informed by Mr. Billups, one of its most intelligent inhabitants, that it begins above the county of Lowndes, of which Columbus is the seat of justice, and extending southerly, through Noxubee county, enters the state of Alabama from the west. According to another authority, it is found in the latter state, in the following counties: Russell and a part of Barbour; Macon and Tallapoosa, with a part of Pike; Montgomery, Lowndes, Dallas, Wilcox, Antauga, Perry, Marengo, Sumpter, Greene, with portions of Tuscaloosa, Pickens, Bibb, and Shelby. This extensive enumeration, however, refers rather to a tract which has the same geological constitution as the prairies, than to a surface destitute of trees and free from overlying deposits of 'sterile sand, gravel, or ferruginous clay,' which constitute the greater part of the surface embraced within those broad limits. The best specimens of prairie-surface, in Alabama, are included in Greene and Marengo counties.* Even the true prairie district is by no means destitute of trees, but abounds in tracts of forest, some of which seem once to have been the beds of ponds or lakes, and are called 'hummocks.' The vegetation of these basins is identical with that of the most fertile limestone borders of the Ohio River, while that of the country generally is entirely different. The prevailing width of this tract, in

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* Mr. C. S. Hale of Mobile, in Doctor Lewis' admirable paper on the Medical History of Alabama: New Orleans Med. and Sur. Jour., Vol. III, No. VI.

the state of Mississippi, as Mr. Billups informed me, is about twenty miles. It was inhabited by the Choctaw Indians, before their removal to their present residence beyond the Mississippi. Geologically, the prairies are the out-crop of a thick formation of soft, cretaceous or rotten limestone, which dips to the south south-west, and has a line of bearing nearly east and west. According to Mr. Hale,* "The lower strata of the series consist principally of silicious sand, with various inter-stratifications of green sand, clay, and limestone; above these is a bed of soft, impervious, argillaceous limestone. This bed, commonly known as rotten limestone, is in some localities from two to three hundred feet thick, while in the others it is found exceedingly thin, but never disappearing. Resting upon this stratum is a deposit of yellow pulverable limestone, which in a few instances is replaced by a pure white carbonate of lime." The soil, consisting largely of the *debris* of this formation, intermixed with the recrements of animals and plants, is extremely fertile. Doctors Cooper and Gibbs, of the College of South Carolina, analyzed two specimens of this soil,— one from a high and dry, the other from a low and humid spot of the same plantation. The former contained twenty-five per cent. of carbonate of lime, and twenty-eight per cent. of organic matter; the latter, fifteen per cent. of carbonate of lime, and twenty-five of organic matter; the other ingredients were alumina and a small quantity of silex and iron. No attempt was made to separate the animal from the vegetable elements of the organic matter. Doctor Lewis supposes the former to predominate, which may be doubted.† As the general aspect of the prairies is level, the rains flow off but slowly, and hence marshes or sloughs are numerous, and every stream has not only a sluggish current but swampy borders. In the summer these surface-waters evaporate; and, as the strata beneath are almost impervious, there is a want of spring and well, not less than of running, water.

IV. THE CANE-BRAKE.— To the south-east, in Alabama, the prairies, as I have already said, are transformed into wood-lands, and covered (where not cultivated) with a dense brake of tall cane. This is the case with portions of Greene, Marengo, Perry, Dallas, and Wilcox counties, quite through to the Alabama River. The black soil of this tract is several feet deep. adhesive, and almost glutinous. Its fertility is exhaustless; but it is as badly watered as the prairies, being, geologically, the very same region.

V. ARTESIAN WELLS.—On the settlement of the prairies and cane-brake, it was soon discovered that they were badly watered. This led to well-digging; which, however, failed to supply the *desideratum*. A feeble percolation or oozing was all that occurred, and no depth of digging procured more than a moderate supply of warm, very hard, and sulphurous water. These excavations, called by the people 'sipe (*seep*) wells,' are now held in small estimation; and the reliance, on all the extensive plantations, is on

* *Loco citato.* † Ibid.

Artesian borings, of which I saw specimens, from Lowndes County, Mississippi, to Greene and Marengo counties, Alabama. Those which I visited, varied in depth from one hundred and twelve to five hundred and twenty feet; which was the depth of that on the plantation of Mr. Billups, in Noxubee county, Mississippi, twenty miles south of Columbus. The water rose within sixty feet of the surface, and he had sunk a well, below that depth, by the side of the boring, to serve as a reservoir, out of which he would pump the water; a common resource, when it does not rise to the surface of the ground. As the strata crop out successively, and constitute the surface of the country, I may give the following statement, derived from him, of their nature, as ascertained by the boring.

Black soil, succeeded by reddish loam, - - - -	8 feet.
Hard, whitish clay, - - - - - - -	4 "
Bluish rotten limestone, with very hard sulphur balls (pyrites),	408 "
Gray sandstone, so hard as to require the pick, - - -	10 "
Then a feeble vein of water, followed by sand—soft sand rock —and finally, by hard, gray sandstone, - - -	90 "

Then a second and more copious supply of water.

In the southern part of Greene county, Alabama, near the residence of Doctor Daney, I visited seven wells of the same kind, the shallowest of which was one hundred and twelve feet; the deepest, three hundred and twenty feet. Water flowed from the whole of them, either in a feeble or strong and copious stream. The depth and temperature of each is presented in the following table, beginning with the shallowest:

No.	Depth.	Temperature.
1	112 Ft.	66° Fah
2	255	68°
3	268	69°
4	290	67°.5
5	307	69°
6	311	67°.5
7	320	67°
Average,	266	67°.71

As some of these borings were in superficial valleys, and others on low ridges, the figures in the second column do not accurately express their depth below the general level of the country. It may be considered remarkable that there should be so little relation between their depth and temperature. The shallowest, it is true, falls one degree and seventy-one hundredths below the average, but the deepest falls nearly three-quarters of a degree below, and one, which in depth is at the average, in temperature is at the maximum. There was no copious and permanent surface-spring in the neighborhood with which to compare them; but a few minutes of latitude to the south, on the Tombeckbee River, not far from Moscow landing, where the limestone has sunk below the river, I found the temperature of a copious spring, which burst out forty feet from the top of a clay and gravel bank, to be sixty-two degrees. As this observation was made on the second day of June, it could not indicate a winter temperature, and, therefore, we may conclude that the difference of five degrees and seventy-one hundredths of temperature, was the result of the difference of two hundred and twenty-six feet of depth, being one degree of increased heat for about every forty feet of descent below the level of the spring, taken as a standard. The water of all the Artesian wells which I visited, had a perceptible sulphurous taste, and, tested with acetate of lead, afforded a white, granular precipitate, indicating, of course, the presence of some muriatic or sulphuric salt; — still it is so soft as to be used by the people for all domestic purposes, without any preparation.

As many of these wells afford a large quantity of water, which flows by night and day, their multiplication, if means should not be adopted to restrain and regulate the discharge, must, at length, create ponds and marshes, which can scarcely fail to prove insalubrious.

In liability to autumnal fever, the prairies hold an intermediate place between the river-bottoms and the sand and loam plains, which bear oaks and pines. I was told by Mr. Bibb, who resides upon the prairies, twelve miles south of Columbus, that, for several years, while he kept his operatives on the slopes of the prairies near the diluvial plain or old bottom of the Tombeckbee, they suffered much from autumnal fever; which led him to remove them a few miles back, where they enjoyed excellent health. He knew of many other cases of the same kind. Mr. Moore, a few miles off, had found the prairies decidedly healthy. In nine years, out of one hundred operatives, but two adults and three or four children had died. Mr. Billups, his neighbor, however, in eight years had lost twenty out of one hundred and twenty; of whom but two were adults; yet eight only of the whole had died of fever. Nevertheless, the prairies, as I learned from various persons both in and out of the profession, may be said to be *subject* to that form of fever; but they are healthier than the cane-brake, in which there is a deeper mold.

VI. Greensboro.—This town, one of the oldest and most noted in Alabama, is situate in about N. Lat. 32° 40′, near the northern border of the prairies, in the west of Greene county, between the sources of Big or Brush Creek and a branch of Big Prairie Creek, both emptying into the Tuscaloosa, near its mouth. The site of Greensboro is undulating and dry. The upper stratum consists of sand, loam, and gravel, being a part of the wide-spread deposit on which Pickensville and Tuscaloosa have been built. To the south and south-west of the town, there are small ravines or valleys, which inclose sluggish wet-weather streams, with marshy borders, having a soil of the richest quality, and producing, along with a luxuriant herbaceous vegetation, a considerable growth of small cane; — hence they are called 'switch-cane marshes' and 'reed-brakes.' These localities, which might, by ditching, be made dry, are at present very unhealthy. In reaching them, we pass for one or two miles over rolling and sandy pine and oak lands. From west round to north, the country is poor and ridgy. Its springs form little streams, with marshy borders from fifty to one hundred yards wide. To the north, at the distance of five miles, is Big or Brush Creek, the valley of which, a mile in width, is a swamp throughout. A farm, on its north or leeward side, has been found one of the most unhealthy in the whole country. To the north-east, the branches of this creek meander in swampy valleys, one of which embraces a mill-pond, and all are insalubrious. To the south-east, there is an extensive slough or swamp, in the neighborhood of which fevers greatly abound. Thus, while the immediate town plat is free from the conditions which generate autumnal fever, they abound in the surrounding country; and the inhabitants of both have, from the beginning of immigration into this region, experienced very violent intermittent and remittent fevers, which, however, are more prevalent in some localities than others.

VII. Demopolis.—This town, one of the newest in the valley of the Tombeckbee, is situated on the left or eastern bank, immediately below the mouth of Tuscaloosa River. On both sides of the latter there are wide bottoms, subject to annual inundations. The site of Demopolis is dry, and elevated above the highest floods of the river. It bears a spontaneous growth of red cedar, and, except the drowned bottoms just mentioned, is more favorably situated as to health than many other towns in the region to which it belongs. The river-face of the bank on which the town is built, shows a formation of cretaceous, semi-indurated limestone, which bears a different aspect from that seen further up the river, as at Pickensville; but it has, like that, a manifest southern dip. The upper layers, which are dry, display an almost chalky whiteness, while the lower and damper are of a light slate-color. The whole presents lines or fissures, more or less perpendicular, some of which contain crystals of carbonate of lime. Nodules of martial pyrites are also common. Near the water this rock softens like marl, and is perforated by some kind of lithodome. Demopolis and its neighborhood are exceedingly deficient in water. The 'sipe-wells' afford but little, and that is almost saturated with lime, and imparts a sulphurous taste. Artesian borings have been resorted to, but the locality is, geologically, too high. One boring, on the town plat, six hundred feet deep, brought up to within ten feet of the surface, a moderate supply of very bad water. Other borings, eight hundred feet in depth, have failed. The resource of the people is in cisterns or wells so lined or plastered as to prevent transudation from the surrounding strata. These are filled by the cold rains of winter, and those of summer are excluded. In this way a very tolerable drinking-water is obtained. The people of Demopolis regard themselves as unfortunate, in not having obtained water by Artesian borings; but they have not gone deep enough to reach the water-bearing stratum. Its depth might be calculated from the angle of inclination of the strata at Pickensville, taken in connection with the depth of the borings west of that town. Everywhere in this region, the Artesian water is considered salubrious; as an evidence of which, Doctor Strudwick, of Demopolis, mentioned to me, that on a plantation of his, the operatives, who had been sickly under the use of the water of a 'sipe-well,' became healthy as soon as he had made an Artesian fountain.

Demopolis, although not so disadvantageously situated as some other towns of Alabama, in reference to those topographical conditions which generate autumnal fever, is by no means exempt from that disease. It has constant steamboat communication with Mobile, but has not experienced yellow fever.

VIII. THE LOWER TOMBECKBEE.—From Demopolis, the Tombeckbee River flows nearly south, to mingle with the Alabama. Not far below the town, as I have already intimated, the cretaceous marl on which it stands, from dipping southerly, disappears beneath the river, whose banks, like those of the Alabama, above Claiborne, are composed of deposits of various-colored loam, gravel, sand, and clay, with wide overflowed bottoms. The eocene or old tertiary limestone is at length traversed, and below, the valley of the river widens, and at the same time becomes deeper. The tides of the Gulf are perceived, I was told, farther up than Jackson, nearly one hundred miles above Mobile, and one hundred and thirty from the open Gulf. The low bottoms embrace extensive cypress swamps with long moss; the distant bluffs have a reddish color. The water of the river has an indescribable, dirty-brown color, with now and then a shade of greenish yellow. Its transparency is greatly reduced. In this condition it unites with the Alabama, sixty-five miles above the city of Mobile. This point, or, rather, the highlands in its rear (for the point is subject to inundation), was once the head of Mobile Bay; and here commences the estuary, of which some account has been already given.*

IX. THE HILL-COUNTRY.—Repeated allusion has been made to the low alpine region, which lies beyond the cretaceous formation, and constitutes, through the northern part of Alabama, a water-shed, from which tributaries of the Tennessee descend to the north, and the various head waters of the Tombeckbee, Tuscaloosa, Cahawba, and Coosa, flow off to the south. The eastern portion of this range, where the Appalachicola, Tallapoosa, and Coosa have their origins, is, on its southern side at least, composed chiefly of primitive rocks, topically impregnated with gold. Further west, transition or Silurian limestone occurs, overlaid or flanked by a coal formation. Thus the geology of the hill-country differs from that of South Alabama, as much as its topography. In regard to the latter, however, it may be remarked that but little of it is really mountainous: the larger part is only hill-country. The streams have a rapid current, which, with the density of the old rocks over which they flow, has prevented their excavating wide alluvial and swampy valleys; while the rugged surface has rendered the formation of ponds and marshes at a distance from the water-courses equally impossible.

Nevertheless, this region, which may be called Middle Alabama, is not ex-

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* New Orleans Journal, *loco citato.*

empt from autumnal fever; which, however, is most prevalent in the vicinity of creeks, even when formed chiefly by copious springs. Doctor, now Professor, Grant, of Memphis, who formerly lived four years in Benton county, between the Coosa and Tallapoosa, near the thirty-fourth degree of latitude, saw, as he informed me, much of this fever, both intermittent and remittent. One summer, after copious spring rains, it invaded the inhabitants of the pine hills. In Jacksonville there is a limestone spring, which discharges a great quantity of water; and it is notorious, that those who live nearest to it, and to the brook which it supplies, are most unhealthy. Doctor Clarke has given nearly the same account of the fevers of the same county. This locality, I suppose, may be taken as the representative of all the hill-country from Georgia through to Mississippi. Of the whole region, Doctor Lewis* remarks, that the "fevers of an intermittent and remittent type, usually make their appearance about the first of July; increasing in number and becoming more violent in the month of August, with occasionally one of a typhoid character; and by the first of September, they have attained their maximum point, and usually begin to decline in October."

SECTION VII.

OUTLINES OF THE REGION BETWEEN THE TOMBECKBEE AND MISSISSIPPI RIVERS.

The Tombeckbee River, of which so much has just been said, originates in the depressed extremity of the western spur of the Appalachian Mountains, which constitutes the water-shed between the Ohio Basin and the Gulf of Mexico. Its sources are chiefly in the north-east corner of the state of Mississippi; subordinately, in the north-west corner of Alabama. Passing from the former to the latter state, at Pickensville, it pursues a course directly south to Mobile Bay, at a short distance from the dividing line between the two states. Its direction is nearly parallel to that of the Mississippi River, from which it is distant, in a straight line, from one hundred and fifty to two hundred miles. Its extreme length, in a straight line, is three hundred miles. Thus, the region on which we have now entered is a parallelogram, with its longest sides nearly in the meridian. It includes the state of Mississippi, and, in its south-west corner, a small part of Louisiana.

Few portions of the Mexican Basin, of the same extent, present as much geological and topographical uniformity, as this region. According to the geological map of Mr. Lyell, compiled from the best authorities,† the whole region embraces but two formations: 1. The post-tertiary and tertiary; 2. the cretaceous. The former extends north from the Gulf of Mexico (between

* Med. Hist. of Alabama: N. O. Journal, before cited.

† Travels in North America. By Charles Lyell, Esq. 1845.

Mobile Bay and the Mississippi River), to a line running across the middle of the state of Mississippi, nearly east and west, from the Tombeckbee River, below Demopolis, to the trough of the Mississippi, above Vicksburg. All above, or to the north of this line, belongs to the cretaceous formation; for the older carboniferous and Silurian groups, which constitute so much of the hill-country of Alabama, do not occur in Mississippi, at least to such an extent as to merit the notice of the medical geologist. The whole surface of the region here sketched out, is composed of loose, miscellaneous ingredients, readily disintegrated, and easily transported by water. Its elevation above the level of the Gulf is small. The highest parts are to the north-east, at the extreme sources of the Tombeckbee; but they do not, probably, exceed six or seven hundred feet, while the greater part ranges from four hundred down to fifty feet. In the south of this region, we have Pascagoula and Pearl Rivers; in the north and north-west, the Big Black and Yazoo; in the north-east, the upper part of the Tombeckbee; nearly all too shallow, narrow, or obstructed, for successful steamboat navigation. An effect of this hydrographical condition is, that the towns of the state of Mississippi are not, like those of Alabama, on the banks of rivers, except those which are found on the Mississippi River. Having already treated of them, and of the localities which lie on the Gulf of Mexico — having, as it were, traveled round the region under inspection, it only remains, in a series of sections, to describe its interior. This, however, I shall not be able to do with much fullness; for I did not penetrate it in many places, and its physicians have not published much upon its medical topography. We shall begin in its south-east corner, with the first river west of Mobile Bay.

SECTION VIII.

BASIN OF PASCAGOULA RIVER.

This out-of-the-way and little-known district, constitutes the south-east angle of the state of Mississippi. Its narrow base, embracing Pascagoula Bay, may be seen on the map of the Delta of the Mississippi (*Pl. V*), and has been already described under the head of Gulf Coasts. The basin of Pascagoula River is intermediate between the Tombeckbee River and Mobile estuary, to the east, and Pearl River, to the west. It embraces, entirely or in part, fifteen counties of Mississippi; and while its mouth is below the latitude of 30° 30′, its extreme sources are in 32° 40′ N. Thus it flows through more than two degrees of latitude. The whole of this basin lies in the tertiary formation, and presents on its level or undulating surface deposits of sand and loam, which, in the northern portions, attain an elevation of four or five hundred feet above the Gulf. Through these loose strata the streams have scooped out their valleys, many of which have considerable breadth. The bottom-lands are fertile, and heavily timbered with the forest trees appropriate to such localities in the south; but are mostly subject to inundations in winter and spring, which greatly limit their settlement and cultivation. Along the Pascagoula River there are, however, old or diluvial terraces, such as have been described on the Tombeckbee, presenting hummocks, which are above the reach of the highest floods. The uplands or plains vary in fertility, from the dry, sandy surface on which the long-leafed pine luxuriates to the exclusion of almost every other tree, through that in which it shares dominion with the oak, to one sufficiently fertile to bear a miscellaneous forest vegetation, when we meet with tracts of the richest hummock. As a general fact, the poorest uplands, and the broadest, lowest, and wettest bottom-lands, are nearest the Gulf. Almost every part of the whole basin abounds in permanent springs, the result of infiltration from the surface.

Mr. Darby* informs us that the "general aspect of the soil on the waters of the Pascagoula is sterile; but on their margins a considerable surface of good farming land exists. Pine forests reach the Gulf of Mexico on both sides of Pascagoula Bay." Doctor Merrill, of Natchez, in 1819 and 1820, was the surgeon of a regiment of troops which cut a military road through this basin, from west to east. He found it a level pine plateau, with but few swamps or ponds. The troops, recently from the north, were subject, in summer and autumn, to a mild and simple remittent fever, of which very few died.† Speaking of that part which lies near the Gulf, Mr. Darby says, its unfruitfulness is counterbalanced, to the inhabitants, by the health they enjoy. According to Besançon, ‡ most parts of it are but little affected with the fevers of autumn; and of one county he says, it is "too healthy to support a physician, too honest to need a lawyer, and too free from debt to furnish any salary to the clerk of a circuit court." On the whole, we may conclude, that the Pascagoula basin affords, in its autumnal salubrity, instructive evidence of the connection, in the manner of cause and effect, between the topographical condition of a southern region and its bilious fevers. If the obstructions to the navigation of the Pascagoula River, which lie at its mouth, and consist of bars formed by the silt of the river and the sands of the Gulf, were removed, so that its deep waters could be entered by steamboats, its banks would afford many healthy, retired, and pleasant retreats, for the people of New Orleans and Mobile, during the sickly season.

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* Geog. Descrip. of La., p. 296.

† MSS. *penes me.*

‡ An. Reg. of the State of Mi., 1838.

SECTION IX.

BASIN OF PEARL RIVER.

I. This basin, which occupies more than half the longitudinal center of the state of Mississippi, extends from the *Rigolets*, between Lake Pontchartrain and Lake Borgne (*Pl. V*), on the Gulf of Mexico, in N. Lat. 30° 10′, to N. Lat. 33° 10′. But, while its length reaches through three degrees of latitude, its breadth does not average more than three quarters of a degree of longitude. It is, in fact, the narrowest basin, in proportion to its length, that can anywhere be found in the Interior Valley. The river, originating in or near the cretaceous prairies, south-west of Columbus, on the Tombeckbee, soon passes the line of junction between that formation and the tertiary, and flows through the latter, by a course nearly south, to the Gulf. Its immediate valley, or trough, is wide, with rich, wooded bottom-lands, almost everywhere subject to inundations, which leave ponds, lagoons, and cypress and liquidambar swamps. The uplands, on each side, are sufficiently level, and through the lower half of the river's length, especially on its eastern side, are covered with pine. On the western side generally, and on both sides as we ascend the river, the land becomes more fertile and rolling, with hummocks, cane-brakes, and even whole counties of productive soil. The tributaries of Pearl River are, in general, very short; but many of them, especially the lower, are fed by copious springs. Most of them flow through wide alluvial valleys, which are less liable to overflows than those of the main stream, yet are not free from swamps and swales, which render their banks unhealthy in autumn. The upper part of the basin, although more productive, is not so well supplied with springs, and, from its richer mold, is more liable to autumnal fever than the lower. Hitherto, Pearl River has been found difficult and precarious in its navigation; in consequence of which it has no large commercial towns to interest the medical topographer. The capital of the state of Mississippi stands, however, on the west or right bank of this river, about N. Lat 32° 20′, and, having made a visit to it, I shall give a sketch of its topography.

II. Jackson.—The immediate site of the town is elevated; some parts of it gradually rising into a considerable swell or tuberosity; though other parts were, originally, a kind of morass, now filled up. Between the town and the river, to the east north-east, there are ponds of clear and cold water, supplied by springs. Extensive low bottoms lie to the north-east, east, and south-west, which are covered by dense forests, and suffer annual inundations. To the west, a small tributary is skirted with narrow, wet, alluvial grounds. Formerly the inhabitants drank a very impure well-water; latterly, they rely chiefly on cisterns, replenished in rainy weather. From Dr. Gist, who has devoted himself to the study of the geology of this region, I learned that, in descending from the surface, there is, *first*, a bed of mold; *second*, a bed of yellow clay or loam, seven or eight feet thick; *third*, a bed of gravel, variable in thickness, but, generally, about three feet; *fourth*, a stratum of blue clay, from eighty to one hundred feet through; *fifth*, sand, of unknown depth. The second and third (loam and gravel) are often wanting. The fourth (blue clay) sometimes assumes a white, gray, or yellow hue. It abounds in beds of indurated carbonate of lime, or rotten limestone, marl, and gypsum; and sulphates of iron, soda, magnesia, and alumina, have also been detected in it. It abounds in marine shells, remains of trees, and bones of land animals. The fifth, or sand stratum, in its upper part, resembles the mud of the river; having decayed animal and vegetable matters mingled with it, and sending up carbonic acid gas. At the depth of a few feet, the sand assumes a white color, and retains it, as far as borings have been made. This bed, which, by its undulations, comes much nearer the surface in some places than in others, abounds in animalcules, of the same kind that are found in the neighboring ponds, which are fed by springs. All the wells which terminate in the blue clay, afford bad water, and likewise some of those which pass through it; but a pure water is supplied by the springs which burst out from the white sand, where it approaches the surface near enough to be cut into by the streams. This interesting description is no doubt applicable not only to Hinds county, one of the largest and richest of the state, in which Jackson is situate, but applies also, with some modifications, to all the northern belt of the tertiary deposits through Mississippi and Alabama.

For several years after the beginning of settlements, this locality was subject to autumnal fevers of a most malignant character; but latterly, they have been much milder. Of the basin of Pearl River, generally, it may be said, that places near the river, and on such of its tributaries as have wide bottoms, are insalubrious; but the pine and oak lands, and other tracts of richer surface, but rolling and remote from water-courses, are comparatively healthy.

SECTION X.

REGION BETWEEN PEARL RIVER AND THE MISSISSIPPI: THE BLUFF-ZONE.

I. In concluding our survey of the region immediately north of the Gulf, we come to the most populous and productive portion of the whole, called by Mr. Darby the bluff-zone. Resting on the Bayou Iberville, on the lower part of Amité River, on Lake Maurepas, and on Lake Pontchartrain, in N. Lat. about 30° 10′, the bluff-zone extends directly north, keeping parallel to the Mississippi River. Its southern end, up to the thirty-first parallel, comprehends the parishes of St. Tammany, Livingston, Baton Rouge, West and East Feliciana, St. Helena, and Washington, all in the state of Louisiana. Washington and St. Tammany, from reaching to Pearl River, are partly included in its basin. Baton Rouge, East Feliciana, and a small part of West Feliciana, rest on the Mississippi. The most important river of this tract is the Amité, which, traversing it centrally, pours its waters into the Bayou Iberville, and gives its name to the united streams.

II. According to Mr. Darby,* a transverse belt of this zone, about twenty miles wide, extending from the Mississippi to Pearl River, rises very gradually from the water-base line which has been described. It is an almost unbroken acclivity, covered, over its whole area, with forest trees, of which the most numerous are the liquidambar, and the quercitron oak. Along the streams, there are cypress, long moss, live-oak, and cane. Near the Mississippi there are vast liriodendrons or tulip-poplars, and over the whole, laurel magnolias. This inclined plain is diluvial, and corresponds with the old or second bottoms of the Tombeckbee, which have been mentioned. Its surface is moderately fertile. Immediately succeeding to this belt, there is another of nearly the same area; 'the surface of which,' according to Darby, 'is broken, often considerably elevated, the soil diversified in quality; near the streams, often fertile, but a much greater proportion covered with pine (*Pinus rigida*), and sterile. Springs of excellent water become frequent, and the creeks and rivers are fine bold streams of very pure limpid water.'

As to fertility, it may be stated that the eastern portions (bordering on Pearl River) of both these terraces, are more sterile and piny than the western. In this quarter we have

III. Madisonville.—The site of this village is on the right bank of the small river Chifuncti, near its junction with Lake Pontchartrain. Its direction from New Orleans is indicated on the map of that city (*Pl. VI*). It is surrounded by pine woods, and constitutes one of the retreats of the unacclimated population of the city, during the prevalence of yellow fever. Its vicinity, and the eastern portions generally of the region we are now considering, are more exempt from autumnal fever than those to the west, which are more fertile, and lie in the rear of Baton Rouge and Bayou Sara, which were described in Chapter V.

IV. We may take another section of this bluff-zone, extending from the thirty-first to the thirty-second degree of north latitude, and lying in the state of Mississippi, immediately north of the preceding. Its position will be best indicated, by saying that the city of Natchez stands near the middle of its western margin. The counties which compose this transverse section of the bluff-zone, are Wilkinson and Amité, adjoining Louisiana, then Adams and Franklin, then Jefferson and Claiborne, with the single county of Copiah in their rear to the east. This region embraces the oldest-settled, and, in many respects, the most interesting portion of the state of Mississippi. The Homo Chitto and Bayou Pierre are its most considerable streams, both of which flow into the Mississippi. Its surface is considerably elevated and rolling—some of it even low-hilly. Although generally fertile, it embraces tracts of pine with thin soil. Nearly one-half of Amité county, in

* Geog. Descrip. of La., p. 92.

which the river Amité originates, is covered with long-leafed pine; while another portion, known as the 'Pine Ridge,' passes diagonally through the county of Adams, to strike the Mississippi a short distance above Natchez. Nevertheless, taken as a whole, this tract is decidedly fertile, and is, or was, clothed with a miscellaneous forest, which overshadowed extensive cane-brakes. In many places, small ponds or sloughs disfigure the surface; and along the streams generally, there are foul alluvial bottoms, subject to inundation. In consequence of this, the most extensive and valuable plantations are on the uplands. Permanent springs are scarce, and the well-water is offensive, and regarded as unhealthy. Though pellucid, it deposits, on standing, a whitish sediment. Most of the wells terminate in rotten (tertiary) limestone. I brought away a bottle of water, from a well of very bad repute, in Jefferson county, several miles back of the river-town of Rodney, already described, which, after the lapse of three years, was examined by Doctor Raymond, who found a spontaneous deposit of crystallized carbonate of lime. All the carbonic acid gas, which kept the lime in solution, and the sulphuretted hydrogen gas, which gave the water an unpleasant smell, had escaped. Except the lime, Doctor Raymond could not detect any foreign matter.

To supply their wants, the planters, in many parts of this district, resort to cisterns. Those to contain drinking water, are filled by the rains in winter; those for stock or other purposes, at any time. Many of these cisterns are from twelve to fifteen feet in diameter, and twenty to thirty feet deep. Some large plantations have several, in different parts, as convenience requires. The stock, not less than the people, prefer this to well-water. As a general fact, all the fertile portions of this region are subject to autumnal fevers. Some account of a few localities will illustrate what has been said.

V. WOODVILLE.—This town is situated fifteen miles from the Mississippi River, in the interior of Wilkinson county. Its elevation above the level of the Gulf is three hundred and forty feet; above the river, at low water, about two hundred and sixty. Its latitude is 31° 7′ N. The geological formation on which it stands, is tertiary sand and clay. According to Doctor Stone and Doctor Kilpatrick, its site is the dry rolling land which separates the head waters of the Bayou Sara, Thompson's Creek, and Buffalo Creek from each other. Some of the small tributaries of the last, originate on the town-plot, and as they flow off to the north, pass through broken pine lands, and are skirted with narrow swamps; but the town and its environs, in other directions, are entirely exempt from stagnant water, which, from the unevenness of the surface, cannot accumulate into ponds or marshes. In every direction around the town, except to the north, there are extensive cotton plantations, which have been cultivated more than forty years. The population of the town is eight hundred. It has always been regarded as one of the most pleasant, and, in reference to autumnal fever, one of the healthiest towns in the south-west; yet, in 1844, it experienced a severe visitation of yellow fever.* Washington, another town of this zone, has been already described in connection with Natchez, from which, its participation in the epidemics of that city, do not permit it to be separated by the medical topographer.

VI. Oakland College.—The site of this rural institution is in Claiborne county, six miles from the Mississippi River. The road from Rodney reaches it over ridges and tuberosities, composed largely of tertiary sand and loam; but the college grounds, and their vicinity, overshadowed by oak trees, are more level. Visiting it in the month of June, I did not see a single spring or stream of any kind; and so great is its destitution of water, that, very often, in summer and autumn, the Mississippi River is the only resource of the inhabitants. The prevalence of autumnal fever, in this locality, is small; but at the distance of three or four miles, where the soil, although dry and rolling, is richer, and produces cane, that disease is common and often violent.

VII. Port Gibson.—Near the central part of the same county, Jefferson, stands the town of Port Gibson; so called because there flows near it a stream, of sufficient depth, in wet weather, to float cotton boats to the Mississippi; from which it is distant ten or eleven miles. The drive to it, from the town of Grand Gulf, was most of the way over hills and ridges, the sides of some of which were rather steep. Before reaching it, the road descended into the broad, low, alluvial valley of the Bayou Pierre; which is composed of two principal branches, that unite near Port Gibson, the site of which is on the left bank of the southern fork. When the Mississippi rises high, the bottoms of the Bayou Pierre are overflowed; and, should that creek at the same time be swollen by rains, the inundation is rendered wider and deeper. The plain on which the town stands is dry, and sufficiently elevated above the stream. I found it clean, and well shaded with trees. It also has a number of wells, from twenty to forty feet deep; and much less cistern-water is drunk here, than in many other parts of the district which we are now surveying. Thus, in the tertiary formation, the water obtained from different strata is by no means uniform in character. To the east of the town, between it and the creek, there are some low, wet grounds; and on the cape or peninsula, above the junction of the two branches of the Bayou Pierre, to the north-east and north, are ponds left by the inundations. In the opposite directions, the country is moderately level, fertile, and free from swamps. Port Gibson is subject to mild attacks of autumnal fever. In the surrounding country it is more frequent and fatal. It has not experienced an invasion of yellow fever.

VIII. A comparison of Localities.—When we compare the two sections of the bluff-zone which have been described, with the basins of Pearl River and the Pascagoula, we find identities and diversities which are worthy of being noted: *first*, they are all included within the same parallels of latitude—all incline to the south—and all belong to the same tertiary deposits; yet,

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* New Orleans Medical Journal, Vol. I, p. 530; Vol. II, p. 40.

secondly, the depth and continuity of fertile soil, and the variety and luxuriance of tree and herbaceous vegetation, are much greater in the former than in the two latter. Now to what causes shall we ascribe this difference? I am not prepared to say that some variation in their mineral constitution may not exist, as an efficient agency in the case, but am inclined to ascribe much of the difference to the contiguity of the Mississippi River, and its wide, swampy, and pondy bottoms. In the great prairies of the west, trees and a rich vegetation are only found near the rivers. On the western side of Lake Michigan, I found a belt of lofty forest, two or three miles wide, with prairie immediately beyond. It appears, then, that river and lake exhalations favor tree vegetation; and to this influence, continued ever since the Mississippi had an existence, we may, perhaps, in good part ascribe the miscellaneous forest and luxuriant herbaceous vegetation, and the rich soil, which distinguish the Bluff-zone from the zones which lie immediately east of it; and which, at the same time, render its inhabitants more liable to autumnal fever.

SECTION XI.

THE BLUFF-ZONE CONTINUED: VALLEYS OF THE BIG BLACK AND YAZOO RIVERS.

I. This section of the zone, east of the Mississippi and west of Pearl River, extends from that just described (the northern limits of which lie between the thirty-second and thirty-third degrees of latitude), up to Lat. 35°. To the west, this section of the zone is limited, for a short distance, by the Mississippi, and afterwards by the Yazoo River; to the east, it is bounded by the upper waters of Pearl and Tombeckbee Rivers. Like the three preceding divisions through which we have just passed, this section of the zone is narrow, especially in its lower part, where Pearl River, by a westerly bend, approaches near to the Big Black. Our paleontologists have decided, that the line of junction between the tertiary and the cretaceous formations of the south, traverses the lower extremity of this section, not far north of the town of Jackson, in the interior, and of Vicksburg, on the Mississippi; so that nearly the whole district on which we have entered, lies in the latter formation. As to civil divisions, no less than sixteen or seventeen counties, in whole or in part, are included within its limits. Those which make up its inferior portion,— Claiborne, Warren, Hinds, Yazoo, Madison, and Holmes,— began to be settled as far back as 1820, or even before: but the settlement of the remainder was at a later period.

As intimated by the heading of this article, two rivers drain the whole of this section. Big Black, the southern and shorter of these streams, originates in Choctaw county, and taking a south-west course, nearly parallel to the Yazoo, enters the Mississippi fifty-four miles below Vicksburg, near the town of Grand Gulf. The county in which this river has its origin, not less than those through which it flows, is sufficiently elevated and rolling; but as the strata are loose and friable, it has scooped out, for the lower half of its course, a broad valley, with depressed and foul bottom-lands, densely overshadowed by tall trees. Even one of its tributaries, Baker's Creek, which I crossed in going from Vicksburg to Jackson, had a valley three or four miles wide, abounding in ponds and swamps; and a family near its banks were at that time, June 21st, afflicted with fever. At a higher point, where the Big Black separates the counties of Yazoo and Madison, its bottoms, as I was told, are wide, and subject to inundation. The Yazoo River originates in the northern counties of Marshall, Tippah, and Pontotoc, under the names of Cold-water, Tallahatchee, and Yallobusha; which streams, flowing to the south-west, descend into the wide Mississippi bottom, unite, and take the name of Yazoo. The course of this common trunk is nearly south, to the Mississippi, which it joins twelve miles above Vicksburg, and sixty-six above the mouth of the Big Black. Of the Sun Flower and other bayous, which are canals of communication from the Mississippi to the Yazoo River across the vast alluvial plain, an account has been already given. The course of the Yazoo is along the bluffs, which terminate this plain to the east, and constitute the western margin of the upland zone we are now studying. The main trunk of the Yazoo belongs, therefore, to the trough of the Mississippi, but the upland streams which form it, and the tributaries which enter its left or eastern side, belong to the bluff-zone, which, from Baton Rouge to Vicksburg, approaches the Mississippi, but is afterwards widely separated from it by the Yazoo Bottom.

This portion of the bluff-zone is nowhere quite level, and in some parts rather hilly. It has but few lakes or swamps, except in the immediate vicinity of its streams, and even these, as we advance to the north, diminish in width. One of the most important counties of this district is Yazoo, into which I traveled to Benton, twelve miles from Yazoo City. The country over which the road passes is elevated and uneven.

II. Benton has for its site a dry and rolling tract, with the low and swampy bottoms of the Big Black eight or ten miles to its east and south-east. The soil of this region is fertile, the natural vegetation miscellaneous, the water of the springs and wells much better than in the bluff-zone further south. Notwithstanding the country at and around Benton does not seem, in any great degree, to favor the production of autumnal fever, that disease is a regular visitant, and often presents malignant cases.

III. Doctor Montgomery has lately published a paper on the Topography and Fevers of Carroll, Choctaw, Tallahatchee, and Yallobusha counties, north of Benton, from which I make the following extract:

"In the above mentioned counties, the face of the country is very much interrupted and broken; the valleys in all, except the western border of Carroll, are very narrow, and confined and contracted by sandy and rocky ridges; no lakes of any importance, very little land subject to overflow, very few ponds of stagnant water, or any place that could be properly called a malarious swamp. The Big Black River touches the south-eastern border of Carroll, and courses through the midst of Choctaw, from its north-eastern to its south-western extremity. There are but few creeks, and those of small dimensions, in Choctaw; and the valleys and creek-bottoms are very small and contracted in that county. In Carroll, we have the Yazoo River, running nearly in a southerly direction along our western border; the Tallahatchee passes through about thirty miles of our north-western corner; Big Black, as before mentioned, courses along the south-eastern angle of the county; thus, these three rivers run nearly from north to south, and the few creeks nearly all run westerly, to empty into the Yazoo. The creeks nearly all dry up in summer, and we have scarcely any ponds of stagnant water. The county of Yallobusha is only coursed by one river, the Yallobusha, which traverses that county from the north-east, running down to the south-eastern extremity, then turning and coursing all along the southern border. There is one large creek, bearing the euphonious name Aattatambogue, which traverses the whole county, running from north to south; and it is worthy of remark, that the people living near the bank of this creek are very exempt from disease. There are a few more small creeks in this county, but of pure, clear water; and no malarious regions of any extent to my knowledge.

"We see, then, from this imperfect geographical outline, that the only local causes of disease in these counties, are from the Big Black in the south-east, the Tallahatchee and Yazoo on the west, and the Yallobusha running westerly from Choctaw, between Yallobusha and Carroll counties. As I have said, all this region, except the Yazoo valley in the west, is very much broken; the soil is rocky and sandy on the hills; the level lands are composed of productive dark-colored loam, with a sub-stratum of clay soils; some freestone, but little limestone; the springs of water are plenty and excellent, mostly rising in sandy strata, some few containing large portions of iron and sulphur. The highlands, by far the most plenty, are covered with the common pine, black jack, and red oak; the valleys are timbered with the gums, poplar, hickory, ash, white oak, elm, beech, &c. There is some little cane in the Yazoo valley."*

IV. North of these counties we come to the culminating line between the Tennessee River, belonging to the Ohio Basin, and the Yazoo River. This water-shed is a westerly continuation of the hill-country of Alabama, but less elevated and not so rugged. Towards its eastern limits some portions are said (by Besançon†) to reach the altitude of eight hundred feet. It abounds in springs. Some of its streams have rapid currents, but others meander through wide bottoms which they overflow. The soil is generally rich, yet certain portions abound in pine, the indication of comparative

* New Orleans Journal, Vol. I., No. 6, p. 538.

† Annual Register.

sterility. In this region, as in the whole bluff-zone down to the Delta of the Mississippi, there are cane-brakes. Besançon informs us that limestone is found in some of the north-eastern counties, which probably belongs to the coal formation; but those nearer the Mississippi are cretaceous. I will, however, reserve some remarks on the medical geology of this region, until after we have traveled over the next.

Autumnal fever is an endemio-epidemic of all parts of the zone drained by the Big Black and Yazoo Rivers; in some localities recurring every summer and autumn with violence, in others, as an occasional scourge.

SECTION XII.

REMAINDER OF THE REGION SOUTH OF THE OHIO BASIN.

I. To conceive clearly of the form and extent of the remainder of the bluff-zone, which is the residue of the great region east of the Mississippi and south of the basin of the Ohio, it is necessary to refer to the remarkable course of the Tennessee River, the southernmost and longest tributary of the Ohio. At the sources of the Yazoo, or the northern limit of the tract we have just surveyed, a little below the thirty-fifth degree of north latitude, the Tennessee River comes within one hundred and twenty miles, in a direct line, of the Mississippi; but it then turns northerly, being deflected by the highlands of Alabama. This northerly course it continues, passing out of the state of Tennessee, and then across the western part of Kentucky, to the Ohio River at Paducah, above the thirty-seventh parallel, and thirty miles in a straight direction from the Mississippi. Throughout this lower section of the Tennessee River, which, by the meanders of the stream, is about two hundred and fifty miles, it receives from the region between it and the Mississippi none but the shortest tributaries; for the water-shed between these two rivers, is everywhere very near to the Tennessee. From this dividing ridge, or culminating plateau, much larger streams, however, descend westwardly to the Mississippi. The most southern is Wolf River, which, in its origin, interlocks with the Tallahatchee branch of the Yazoo, and finally joins the Mississippi at Memphis, Tennessee. Next, advancing north, we have the Big Hatchee, which likewise rises, in part, from the same summit, and, by a circuitous course, enters the Mississippi at Randolph, sixty miles higher up. Then succeeds Forked Deer River, and lastly Obion River; after which, up to the Ohio River, there is no stream worthy of being noted. Such is the hydrography of the district we are now studying. Politically, it comprehends the western district of Tennessee, and the western extremity of the state of Kentucky. Its surface is either level or undulating, except near the streams, and between their sources and those of the tributaries of the Tennessee, where it becomes more elevated and hilly. Every part of it belongs to the cretaceous formation, which, however, must be very thin in its northern margin. The rivers are sluggish in current, and, flowing through a loose surface, have excavated wide troughs, with low alluvial bottoms, which are liable to frequent inundations. In traversing this tract from Memphis to Savannah, on the Tennessee River, the road passing through Raleigh, Somerville, Bolivar, and Purdy. I found the soil generally red, and where the streams had cut down forty or fifty feet, their banks exhibit the same hue quite to the water's edge. The stony fragments, in which the loam abounds, seem to prove that the latter is a decomposed conglomerate or pebbly sandstone; while the color of the soil shows that oxyde of iron was the cement. Stone of that kind is here seen *in situ*, increasing in quantity as we advance farther from the Mississippi. A notice of two localities — one low down and the other high up — on the Big Hatchee, will serve as specimens of the district.

II. TIPTON COUNTY. — Doctor Harper* has given us a sketch of the medical topography of this county. Bounded on the west by the Mississippi, it is traversed nearly through its center by the Big Hatchee. The river, and its tributaries, are bordered by low bottoms, from one to two miles wide, which are bounded by high banks on either side. The streams are crooked, and in winter and spring overflow the bottom-lands, which are mostly too wet for cultivation, and remain covered with their original forests. For ten miles from the Mississippi, the surface is hilly; but the eastern part of the county is more level, and is the chief seat of cultivation. This county is subject to autumnal fever; often congestive or malignant. It prevails more in latter years, than when settlements were first made; and more in dry summers than wet.

III. BOLIVAR.—This town, the most important of the interior, is situate sixty-five miles east of Memphis, on the south or left bank of the Big Hatchee, from which it is distant one mile. It stands on a plain, that slopes gently to the river; which is a deep, sluggish canal, not more than one hundred feet in width. Although between two and three hundred miles, by its meanders, from the Mississippi at Randolph, steamboats ascend it to this point. The bottom is here a mile wide, and subject to deep inundations. A dense forest, embracing cypress trees, overshadows it. Beyond this alluvium the land rises to the hight of from eighty to one hundred feet, and presents ledges of perishable sandstone and conglomerate. The wells, in Bolivar, are from sixty to seventy feet in depth, and afford much better water than those of the cretaceous region, further south. The following strata are generally passed through, in digging: 1, Clay or loam, from five to fifteen feet; 2, red sand, from fifteen to twenty feet; 3, very white sand, from fifteen to twenty feet; 4, red and white sand mingled, but ending in pure white, with excellent, soft water.

IV. Doctor Higgason, of Somerville, speaks as follows of the whole Western District: †

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* Western Journal, Louisville, Aug., 1846.

† Transylvania Journal, Vol. VIII, p. 39.

"The face of the country is generally uneven, presenting a variety of hill and dale, sufficient to give a pleasing diversity to the eye. Approaching the eastern portion, the land becomes a little more broken, assumes a bolder feature, and presents an approximation, in character, to the mountain scenery on the other side of the Tennessee River. This feature obtains, in some degree, along the Kentucky border, and down the Mississippi River to some extent, until it is lost in the beautiful undulations, scattered over the general face of the country.

"The whole country, so far as geological observation has extended, is of secondary formation, composed of layer upon layer of loam, and clay, and sand, intermingled with various kinds of earth, and shells, and vegetable substances, disposed in such manner, as to induce the idea of being deposited at distinct epochs of the earth's history. In passing through different strata of sand, it is not unusual to find silicious pebbles; as if they had formed a river or an ocean's bed, and had assumed their present form by long-continued attrition. The impression of twigs and leaves is common in clay; and, not unfrequently, the trunks of trees, changed to a kind of bituminous substance, are found at the distance of forty or fifty feet below the surface of the earth.

"Rivers are numerous here; perhaps no country on the globe is more liberally supplied with navigable streams than this. Sandy and Beach Rivers flow into the Tennessee, on the east; Wolf, Loose Hatchee, Big Hatchee, Forked Deer, and Obion, into the Mississippi, on the west; these, having their sources in, or passing through, some portion of the district, afford advantages to the farmer and merchant, rarely equaled in any part of the world. There is no point more than twenty-five miles distant from a navigable water-course. Creeks and rivulets, of sufficient size to propel machinery, are to be found in almost every neighborhood; sometimes, however, in dry seasons, they become deficient, on account of the absorbent quality of the soil. Dry creeks, as they are called, are scattered over the whole country; they wind their way among the hills, and continue flush until June, when they become dry, and remain so until the winter rains set in; with the exception of here and there a pool, standing in the deeper part of their beds. They are attended by little or no swamp or marsh; but by a strip of rich, level land, that becomes sufficiently drained for cultivation, by the planting season. The perennial streams carry along with them a low, paludal land, from a half to four or five miles in breadth, corresponding, in some measure, to the size of the water-course. This land is frequently inundated to its full extent by spring freshets, and on the recession of the waters, numerous sloughs and lakes are left, that remain stagnant, until drained or carried off by a slow evaporation.

"These low grounds give origin to a heavy growth of forest trees and shrubbery, that almost excludes the solar rays. The atmosphere is consequently heavy, and loaded with exhalations from decomposing animal and vegetable matter, left by the retiring waters. On the higher lands, the forest is not so heavy, and under-brush less abundant; until here and there a patch of barren ground is presented, with scarcely a sufficient growth for the uses of husbandry. This obtains, to some extent, over the whole district, and is much sought by the planters, particularly when situated adjacent to lands heavily timbered, and yielding the supplies requisite for farming purposes. Small prairies are here and there found, which appear to have been produced by an extension of the same natural causes with the barrens. They both are light, and porous, and fertile; both alike suited to vegetable nutriment; both equally adapted to the growth of cotton, the different grains, and grasses; and no geological distinction can be detected, sufficient to account for the absence of forest trees. In their immediate neighborhood, good spring-water is generally scarce; probably owing to the direct rays of the sun on an alluvial soil, favoring an evaporation so rapid as to prevent that absorption and percolation of water necessary to the formation of springs. Good well-water may, however, be procured in almost every part of the country, at the distance of thirty or forty feet. This is of the temperature of sixty-two degrees Fahrenheit, and is considered more wholesome than that of springs. Whether this is owing to the greater purity of the one, or the low marsh-land usually accompanying the other, is a point in question. Certain it is, that families using well-water are more exempt from disease than those using the water of springs. There is in the vicinity of Somerville, a fine, bold spring of clear, freestone water, from which the citizens of that village were supplied for some years after its first settlement; during which period it was unhealthy. Diseases of a violent and dangerous character prevailed, particularly in the summer and fall of 1826; almost every case that occurred proved fatal. Since then, well-water has come into general use, and the village is comparatively healthy; diseases are less common, and of milder character than before. A greater improvement has taken place in this respect, than may be ascribed to modes and habits of life."

To this comprehensive account may be added a briefer notice, from another physician of the same district: *

"The Western District," says Doctor Travis, "is generally a low country, abounding in many water-courses, upland ponds, and extensive marshy bottoms, on each side of every river, creek, and branch. The rivulets, in general, have but little fall. Mill-ponds are common; and, in consequence of the level surface of the earth, immense bodies of land are covered with water. The soil is fertile and covered with vegetation." According to Doctor Travis, intermittents of a malignant type are among the varieties of autumnal fever in this district.

In addition to these authorities I may add, that all parts of the region we

* Transylvania Journal, Vol. I, p. 423.

are now exploring are subject to autumnal fever; but, with the exception of some localities, it is less frequent and fatal than in regions further south.

V. COTTON LIMIT.—In the Western District we have the northern limit of cotton cultivation. The thirty-sixth degree of latitude is that at which it ceases to be a reliable and profitable crop; though its cultivation, in a limited way, extends half a degree further north. Thus cotton bears to the thirty-sixth parallel, nearly the same relation which the sugar-cane bears to the thirty-first — the climatic difference between them being five degrees. In the larger towns of the sugar-zone, yellow fever is, *apparently*, an endemic disease; beyond that belt, an occasional epidemic; but it has not yet reached the northern boundary of the cotton-zone.

SECTION XIII.

A GEOLOGICAL SECTION.

I. In concluding the topographical description of the country east of the Mississippi and south of the Ohio Basin, composed almost entirely of the cretaceous and tertiary formations, it will be acceptable to the medical geologist to have a summary of the original observations of a traveler,* extending from Troy, in Obion county, Tennessee, N. Lat. 36° 20′, a few miles north of Obion River, to Centreville, Alabama, on the Cahawba River, in Lat. 33°; the general course of his route being south south-east.

Around Troy, the country is level or a little rolling, and the wells reveal nothing but clay, which is so tenacious that no curbing is needed. Beginning somewhere north of that town, and extending to Cold-water River, in the state of Mississippi, one hundred and thirty miles south, Mr. Christy everywhere saw the same upper stratum, which he has designated as No. 1. It consists of a heavy deposit of clay, which includes beds of leaves, black dirt or mud, and logs or trunks of trees, not petrified. Obion, Forked Deer, Big Hatchee, and Wolf Rivers, have their troughs in this stratum. Beneath it is a stratum of sand, No. 2, about one hundred feet thick, which presents white, red, and yellow layers, and includes, in irregular dissemination, beds of gravel and pipe-clay. When wells are sunk through this stratum of sand, the quantity of water is so great as to indicate a subterranean stream. Cold-water River has cut its bed so deep into this stratum, as to draw a large supply from it; and hence, perhaps, that temperature which suggested its name. In some places, these outbursts of water have the diameter of a hogshead. The upper stratum of clay, No. 1, extends to near Holly Springs, Marshall county, Mississippi, but is attenuated, and only found capping the low eminences of the sand stratum, No. 2. This stratum extends as far south as the Tallahatchee River, in the southern edge of the county just

* Letters on Geology. By David Christy, Oxford, O., 1848.

named, where it is cut through by the river, and a lower bed, No. 3, is exposed, consisting of clay, including thin strata of ferruginous sandstone, and occasional beds of iron ore. It also contains trees which are silicified. Beneath this, in the same locality, is a stratum of sand, with beds of massive sandstone, in its lower part; — this is No. 4. A stratum of clay, constituting No. 5, is found in the same locality, imbedding lignite, black mud, and impressions of leaves. Pontotoc, Mississippi, between the sources of the Tallahatchee and the Tombeckbee, stands on this, which is a pine-bearing stratum. Below this deposit, is No. 6, a thin bed of sand; then, No. 7, a bed of clay; succeeded by No. 8, a marly clay, with beds of limestone, and unconsolidated marine shells. No. 9 is red sand; on which follows No. 10, the great deposit of marlite, or rotten limestone so often mentioned. Its first appearance is a few miles south of Pontotoc. From this town to Houston, thirty miles directly south, the road is over Nos. 8, 7, 6, and 5. At Houston, No. 9 makes the surface, and No. 10 is only twenty feet below. From Houston to Starkville, thirty-seven miles, still nearly south, No. 9 is uppermost for more than half the distance; when No. 10 rises so high, that the other is only found capping the hills. Mr. Christy had now reached the great cretaceous soft or rotten limestone formation, which stretches from Octibbeha county, of which Starksville is the seat of justice, and Lowndes county, of which Columbus is the chief town, round to the Alabama River. He traced it through the prairies, to Centreville on the Cahawba, and made many observations on its mineral, as well as its paleontological character; but, as we have already said as much concerning it as etiology seems to require, we shall not follow him further.

II. Conclusion.—In concluding this chapter, a few facts deserve to be reproduced to the reader:

1. The whole region which has been surveyed, lies south of the thirty-seventh degree of north latitude, and its broadest part is in the thirty-second; — it is, therefore, a southern region.

2. Its elevation above the Gulf of Mexico is but small, not averaging more than four hundred feet.

3. It has an inclination to the south; which is true even of those parts which discharge their waters westerly and south-westerly into the Mississippi.

4. It is composed of the (geologically) recent cretaceous and tertiary formations, which are friable in texture and miscellaneous in composition, still containing remains of organic matter.

5. As a consequence of this structure, its streams have wide alluvions, and sluggish currents, which lead to frequent valley-inundations.

6. It is undeniable, that this great region is more generally and seriously infested with autumnal fever, than any other portion of the Interior Valley of North America.

7. Most of it has been settled within the last thirty years, and new plantations are still forming.

It is, therefore, what we, provincially, call a new country, and with the progress of cultivation, may become much healthier. Most of its streams, however, will long continue to overflow their low, broad, alluvial bottoms, and thus thread the higher lands with lines of pools and swamp, which, under the influence of a southern sun, will of necessity send forth the efficient cause of autumnal fever. The question, moreover, may be raised, whether, in summer and autumn, there may not be telluric emanations, from the unconsolidated strata of the comparatively recent tertiary and cretaceous formations, which the older carboniferous, Devonian, and Silurian formations do not send forth. I would not venture to answer this question affirmatively; but if such be the case, the region we have surveyed is permanently exposed to an additional cause of insalubrity.

CHAPTER IX.

THE SOUTHERN BASIN, CONTINUED.

MEDICAL TOPOGRAPHY OF THE REGIONS EAST OF THE MISSISSIPPI: THE OHIO BASIN.

SECTION I.

LIMITS AND GENERAL FEATURES.

In entering this basin, we rise from The South-West to The West, into the region which, thirty years ago, was, in common parlance, called the Valley of the Mississippi; for, at that time, the settlements beyond that river were exceedingly limited, and most of those in the south-west were but beginning. The central states of the Ohio Basin are Kentucky and Ohio. The former, except its farthest western extremity, which rests on the Mississippi, is more entirely within the Ohio Basin than any other state. To the south of Kentucky, the state of Tennessee, the northern end of Alabama, the north-west corner of Georgia, and a larger portion of the south-west angle of North Carolina, lie within this basin; to the east of Tennessee and Kentucky, other portions of North Carolina, and the whole of Western Virginia, belong to this basin; east of the state of Ohio, the western third-part of Pennsylvania, and a portion of the south-west corner of New York, dip into the same basin; the northern part of Ohio, and, west of it, of Indiana and Illinois, likewise appertain to the Ohio Basin, of which the western limit runs through the state of Illinois from north to south, so as to include about a fifth-part of that state. Thus, while no single state lies entirely in this basin, Tennessee, Kentucky, Indiana, and Ohio are chiefly in it, and constitute what is, or was formerly, called The West. In addition to these, eight other states discharge a portion of their waters through the Ohio River; making in all twelve states, which are hydrographically connected with this basin. Of all the basins of the Great Interior Valley, this approaches nearest to a circular figure; its central and intersecting diameters conforming to the cardinal points, and being nearly of the same length. Its center would be included within a line drawn through Maysville and Lexington, Kentucky; Madison, Indiana; and Cincinnati, Ohio; between the thirty-eighth and thirty-ninth parallels, and the eighty-fourth and eighty-fifth meridians. Its most southern latitude, on the highlands beyond the great bend of the Tennessee River, is in the state of Alabama, about thirty-four degrees and fifteen minutes; its northern, in New York, a little above the forty-second degree. In longitude it ranges from about seventy-eight to eighty-nine west. The former of these meridians runs through New York and Pennsylvania, at the sources of the Alleghany River; the latter passes through the mouth of the Ohio River.

The Ohio Basin differs, in many respects, from the more southern basins over which we have traveled. Its general elevation above the level of the sea, excluding its mountains, is more than twice as great as the regions we have just left — that is, from seven hundred to one thousand feet; while the mountain borders to the east and south-east, rise from two thousand five hundred to five thousand feet. The north-west portions, in Illinois, Indiana, and Ohio, embrace tracts of level land, not unlike the plains of Alabama; but south of the Ohio River, the surface is everywhere ridgy, rising eastwardly into the mountainous; a character which belongs equally to the eastern portions of the region north of the Ohio.

Geologically, the difference is equally great. A very small part, near the mouths of the Ohio and Tennessee Rivers, presents the cretaceous formation, on which we have dwelt so long; all the rest offers at the surface older geological formations. The western, southern, and eastern parts embrace extensive coal deposits, with their accompanying sandstones, shales, and limestone; the central portions show at the surface Devonian sandstones and shales, of an older geological date; and large tracts of Silurian limestone, still older in the geological series, are found at the surface; the carboniferous and Devonian formations seeming to have been washed away. The oldest of these Silurian or transition rocks bulge up in, and a little south of, what has been designated as the geographical center of the basin. The rocks of these various formations are firmly indurated, compared with the cretaceous and tertiary deposits, and have, therefore, been acted upon much less in a lateral direction. Hence most of the valleys are mere ravines, compared with those which have been excavated through loose and friable strata. This is especially true of that part of the basin which lies south of the Ohio River. To its north, however, in Illinois, Indiana, and Ohio, there are deep and extensive deposits of drift or diluvium, in which the streams have excavated wide valleys, and formed alluvial bottoms of corresponding breadth. All parts afford springs, though not of equal copiousness and permanence, and well-water can everywhere be obtained. The creeks and rivers rise rapidly, and the range between low and high water is great. In the northern margin of the basin, there are many small lakes, or, more properly speaking, large ponds, and numerous swamps of still greater area; but in the basin generally they are not found.

To the north of the Ohio, in Illinois, Indiana, and Ohio, there are considerable tracts of prairie; but the basin generally presents, or did present, compact and lofty forests, composed of the diversified tree vegetation of the fertile soils of the middle latitudes. The pines, hemlocks, and other resinous trees, are chiefly found in the mountains of Western New York, Pennsylvania, and Virginia.

As is implied in the name given to this basin, its great river is the Ohio, the general course of which is west south-west. Its principal tributaries on the north side, beginning with the lowest and ascending, are the Wabash, Great Miami, Scioto, Muskingum, and Alleghany; which last is, in fact, the Ohio, under another name. On the south side we have, beginning with the highest and descending, first, the Monongahela, the junction of which with the Alleghany, at Pittsburgh, forms the Ohio; then the Kenawha, the Sandy, Kentucky, Green, Cumberland, and Tennessee. As a general fact, the rivers on the north side have a shorter course and a more rapid descent, than those of the opposite side of the Ohio.

SECTION II.

TROUGH OF THE RIVER.

From the mouth of the Ohio to that of the Tennessee, that is, from Cairo to Paducah, the distance is forty-five miles, following the Ohio in its bend to the north. Through the whole of this section, which may be called the estuary of the river, the current is slack and gentle, indicating very little fall, except when there is a flood in the Ohio, and, at the same time, low water in the Mississippi. The river, in the lower part of the estuary, is expanded to a breadth even greater than that of the Mississippi where they unite. Its banks, for much of the distance from its mouth up to the Tennessee River, are low, and its bottoms so wide that no hills can be seen. Large tracts are, of course, annually overflowed, early in the spring by the Ohio, later by the Mississippi, and occasionally by a simultaneous flood in both. These inundations leave ponds, and extensive swamps, heavily shaded with sycamore, cotton-wood, water-maple, and liquidambar, on both sides of the estuary. Here and there a clay or gravel bank, cretaceous, tertiary, or diluvial, rises above high-water mark; but in its rear there is, commonly, lower and pondy land. A ridge or terrace of this kind is seen for some distance, on the north side of the river, between Cairo and Paducah, producing cane of a diminutive size, and having ponds in its rear. The only towns of any importance on the estuary are, Cairo, at the mouth of the river, already described when treating of the trough of the Mississippi, and Paducah, immediately below the mouth of the Tennessee River. The scattered inhabitants between these places, not less than the people of the former, are subject to autumnal fever, which occasionally shows a malignant character. The depression of this portion of the valley below the high-water level of the Ohio and Mississippi, must forever render it liable to this form of fever.

From the Tennessee River upward to the mountains, the banks are more elevated than below, and second terraces are everywhere met with. Even a third is occasionally seen. The former are rarely so low as to be reached by the highest floods of the river; the latter, of course, always above them. The first bottoms are mostly argillaceous, with a deep soil. The second and third consist largely of bowlders, pebbles, gravel, and sand, covered with a stratum of yellow loam, overspread with a thin layer of soil. Their surface is generally dry. The *debris* of which they are composed, are all water-worn to a polished surface, except those which obviously belong to the adjacent strata. The sand is almost invariably in the deeper parts of these deposits, while the other and larger masses are found nearer the surface; showing that they have been agitated by the fluctuations of stagnant water; a further evidence of which is, that the materials are, imperfectly, disposed in strata, which at considerable depths are variously curved and inclined, but near the surface are generally horizontal. Among the pebbles and small bowlders, there are fragments of all the different rocks yet discovered to the east, north-east, and north of the river; and the further we ascend it, the larger are these masses, and the more extensive the upper or second bottoms which they compose. In their depths, beds of tenacious blue clay are occasionally met with, and fragments of trees, with *unios*, and other fresh-water shells, of the existing geological era. Detached and water-worn teeth and vertebræ of the mastodon and arctic elephant are likewise found. Well-water of a hard and sometimes sulphurous quality, but generally palatable and salubrious, is obtained at various depths, from twenty to one hundred feet. In some places, where there is a third terrace, the *debris* are consolidated, by oxyde of iron, into a coarse, stratified conglomerate. All the beautiful town-sites and valley-residences along the Ohio, are seated on these old bottoms, which are called by the geologists diluvial or post-tertiary deposits. The first or lowest bottoms, lying between these and the river, are sometimes wider, sometimes narrower than the second. They are generally composed, as already intimated, of clay,—yellow, reddish, or blue,—with more or less marl and sand. When the last is abundant, they are easily washed away. They also inclose fragments of wood, and detached bones, or even whole skeletons, of extinct as well as existing mammalia. The water they afford is often not so pure as that obtained in the gravel plains, and frequently contains the bicarbonate of iron. These low terraces, and also the higher and older, generally incline from the river, and hence the water which descends upon them from the hills, or falls in rain, does not flow directly to the river, but takes a course more or less parallel to it, forming swampy streams, which slowly discharge themselves into the hill-tributaries of the river.

In former times, these marshy brooks were dammed up by beavers, and converted into ponds, overshadowed by the forest, and half-filled with dead and decaying trees. The declivity of these, like that of other alluvial bottoms, was produced by the greater deposit of silt near the margin of the bank than further back. In ordinary floods, the river no longer passes over its banks, but throwing its back-water up the estuaries of its tributary streams, and into the beaver-creeks, spreads over the rear of the bottoms, producing on many of them a deep inundation, while a margin of dry land remains in front. When the flood recedes, a new deposit of silt and drift-wood is left, with sloughs and ponds, which dry up more or less rapidly, according to their depth and the degree in which they are fed by springs from the adjoining hills.

Such is the general character of the trough or immediate valley of the Ohio. It only remains to add, that this valley, from *hill to hill*, has a width which varies from one to two miles, and that, except where considerable tributaries enter, the bottoms are rarely of the same width on both sides at the same place, but present the wide and narrow in alternation. Of the hills it may be stated, that they generally rise about four hundred feet above the lowest level of the river, are steep, and divided by narrow ravines, but are covered with productive soil, and sustain a vigorous and lofty growth of forest trees. They constitute a rugged zone on each side of the river, which, at a short distance back, graduates into undulating or level land, until we ascend the river about six hundred miles, to the outcrops of the Appalachian coal formation, when the whole surface of the country becomes more broken.

Having made this general survey of the basin and trough of the Ohio River, we must now proceed to more particular topographical descriptions. In doing this, it will be proper to begin with the lower tributaries on the south side; as we shall then start from the terminal line of the last chapter. The localities along the Ohio River, will be described (as far as I have materials) as we pass from the mouth of one tributary to that of another. We, of course, commence with the Tennessee.

SECTION III.

SOUTHERN OHIO BASIN: THE TENNESSEE RIVER.

I. The Tennessee River has sometimes been compared with the Ohio, which it almost equals in length, and in some places rivals in breadth; yet, to the medical topographer, the interest it presents is far less. Its sources, in the mountains of Virginia and North Carolina, are found as far north as the thirty-seventh parallel; which is that of its mouth, in the state of Kentucky; while its middle is bent down, in the state of Alabama, to the thirty-fourth degree. Through the first half of its course the Tennessee is, strictly speaking, a mountain river; but afterwards, it flows through a hill-country. For three-fourths of its length, the Appalachian Mountains, and the declining spurs which they send off, westwardly, across the state of Alabama, restrain it on the south; while the Cumberland River, which conforms to its great curve, approaches it so closely on the opposite side, as greatly to narrow its basin. Hence, after its formation by the Clinch and Holston, at Kingston, six hundred miles from its mouth, it does not receive a single tributary wide and deep enough for steamboat navigation. This limitation of its basin, taken in connection with a number of shoals and rapids, has combined with the hilliness of many parts of the country through which it flows, and the narrowness of most of its alluvial grounds, in retarding the settlement of its banks, and rendering their study an object of interest to the medical etiologist. From its mouth to its sources, the banks do not present a single town with one thousand inhabitants; nor is there a town within its basin that contains more than that number.

In continuing the description, we may conveniently divide this river into the Lower and the Upper Tennessee, taking the Muscle Shoals, between Florence and Triana, as the line of division. The length of the lower section is about two hundred and seventy-five miles. Through most of this distance, the country on each side is somewhat rugged, and composed largely of carboniferous limestone; which, however, is often found only in the bed of the river, while the hills are composed of, or capped with, the rotten or cretaceous limestone;—as I had an opportunity of observing, on the route from Memphis, through Purdy and Savannah, to Florence. The bottom-lands of this section of the Tennessee, are said not to be very broad: there is no great prevalence of ponds and swamps, compared with the rivers farther south: and their liability to autumnal fever is in correspondence with this topography.

II. Florence, in North Alabama.—This town, one of the oldest in the basin of the Tennessee, stands on its right or northern bank, not far below the Muscle Shoals. Its site is on the southern edge of a considerable tract of table-land, elevated from eighty to one hundred feet above the level of the river, free from ponds and sloughs, and subjected to cotton cultivation. Between the town and the river, which here runs from east to west, there is an alluvial bottom, a quarter of a mile in width, which is subject to inundation, and constitutes the chief source of autumnal fever in this locality. The inhabitants obtain their drinking-water from wells. They are dug to the depth of sixty or eighty feet, through loose materials — coarse red sand and clay, abounding in detached organic remains and moldering fragments of silicious stone. The water is soft, and of the temperature, in June, of sixty-one degrees Fahrenheit. Like other river towns in the latitude of thirty-five degrees north, Florence is visited annually with autumnal fever, which, however, is in general of a mild character.

III. Tuscumbia.—The plain on which Florence stands reappears on the south side of the Tennessee River, and stretches off eight or ten miles, to the mountain highlands, which constitute the water-shed between this river and the Coosa, which flows to the south. On this plain, the surface of which is gently undulating and of a reddish color, at the distance of four miles from the river, in the midst of extensive cotton-fields, stands the newer town of Tuscumbia. The most interesting object in the topography of this place, is a spring, which, almost in the center of the village, gushes from a ledge of carboniferous limestone rocks. The pool which it forms is beautifully overshadowed by trees; the water displays a bluish tint, and abounds in long wreaths of aquatic plants. Its temperature, in the month of June, was sixty degrees Fahrenheit. In flowing off, it expands into a brook thirty yards in width, which very soon joins itself with a surface-stream; and the united waters, under the name of Spring Creek, make their way, north-westerly, to the Tennessee River, three miles from the town. This creek, flowing through the loose upper stratum of the plain, has formed wide alluvial bottoms, which are occasionally inundated; and hence Tuscumbia has, to its windward, a permanent source of autumnal fever, from which it annually suffers.

IV. The Muscle Shoals and adjacent Plain.— I did not visit the Muscle Shoals. Their length is sixty or seventy miles. The river is divided into many channels, in which the water is in some parts slack, in others rapid. Islands, of course, are numerous, and the breadth of the whole trough very great, compared with that above or below. To the south, through the whole length of the shoals, lies the plain on which Tuscumbia is built; and in traversing it for a distance of forty-three miles by the railroad, to Decatur, above the shoals, the low range of terminating Appalachian Mountains, which stretches across North Alabama, is everywhere in sight to the south. The width of this plain is from six to ten miles. Although it is, except near the river, above the highest floods, its surface is not free from ponds and sloughs; and its inhabitants, including those who live in the village of Courtland, are subject to autumnal fever.

V. Decatur stands on the eastern edge of this plain, and is less elevated above the river than Tuscumbia or Florence. It seems to be free from special sources of disease, as far as the plain around it is concerned, but is not beyond the reach of sinister influences from the opposite side.

VI. Route from Decatur to Huntsville.—The river at Decatur is nearly half a mile in width, with shallow and stagnant water in the summer. Its north or right bank is low, and the road passes for two or three miles over a causeway, in the midst of foul ponds, lagoons, and swamps, left by the spring inundations of the river; — beyond this bottom, it mounts on table-land of the same kind with that on the opposite side of the river. From this plateau, which is several miles in width, the road rises to the summits of a tract of low hills; from the north-eastern edge of which, we look over the plain, on which stands the most noted and beautiful town in the Tennessee Basin — Huntsville.

VII. Huntsville is environed by spurs and off-sets of the Cumberland branch of the Appalachian Mountains, which repose around it in blue masses. This town enjoys the advantages of a fountain as pure and copious as that of Tuscumbia. Its surplus water is made to supply a canal, which is conducted along its valley, in a southerly direction, to the Tennessee River,— a distance of twelve miles. In this valley and the smaller lateral valleys opening into it, there is much drowned bottom-land, and, consequently, the people of Huntsville are not without annual visitations of autumnal fever, some of which are severe. There is no town in the south-west, the streets of which are better protected from the sun by shade-trees than this. In Mississippi and Florida, up to north latitude thirty-three degrees thirty minutes, the pride of China (*Melia azedarach*) is the prevailing shade-tree. Here, as at Memphis, about the thirty-fifth degree, it is replaced by our native white-flowering locust (*Robinia pseudacacia*), the branches of which are longer and tougher than in the higher latitudes.

VIII. Monte Sano.—The insulated and conoidal mountain which has (not inappropriately) received the attractive name of Monte Sano, rears its head in sight of Huntsville to the east. By two barometrical admeasurements, Doctor Thomas Fearn has determined its altitude to be ten hundred and ninety feet above the town, which itself cannot be less than six hundred feet above the sea, making the positive elevation of the mountain nearly seventeen hundred feet. Resting on carboniferous limestone, it belongs to the coal formation, and presents thin strata of that combustible amid its sandstones and shales. About nine hundred feet from its base, a copious spring bursts out on its northern declivity, the temperature of which, in June, was fifty-four degrees Fahrenheit. Taking the heat of the spring below at sixty degrees Fahrenheit, we have a diminution of one degree of temperature for one hundred and fifty feet of ascent. The zone at the altitude of the upper spring sustains nearly the same vegetation as the banks of the Ohio in the latitude of thirty-eight and thirty-nine degrees, where the mean temperature of the year is about fifty-four degrees. The summit of the mountain presents a limited plateau or table, from the margins of which, on every side, we look down into coves and valleys, where it often rains, as I was informed by Doctor Fearn, from clouds which do not rise as high as the mountain.

Such is the lofty, picturesque, and salubrious summer-retreat of the people of Huntsville, who have erected many hot-weather cottages upon it. They do not, however, entirely escape the fevers of autumn; for, in rainy seasons, those maladies have sometimes invaded their summer asylum.

IX. WHITESBURG.—Doctor Capshaw * has given us a sketch of the topography of this small cotton-shipping town, situated on the right bank of the Tennessee River, eleven miles from Huntsville.

"The country in this vicinity is diversified; on the east we have a ridge of mountains making in toward the river, while to the north and west are a few scattering spurs and knobs, rising from a general plain but little elevated above the banks of the river. The plain is so much cut up with ponds and sloughs, as to have given currency to the local appellation of *Pond Beat.* During high tides in the river, about one-sixth of the surface is subject to inundation. The lands not occupied by mountains, and free from overflow, are generally of good quality, and mostly reduced to cultivation. The inhabitants number about nine hundred, two-thirds of whom are slaves, employed in the production of cotton. The prevailing diseases are of malarious origin, and chills are so common that few are so fortunate as to escape them a whole year."

We must now leave this portion of the river, as I am under the necessity of conducting the reader along the routes which I traveled, not having materials for a full description.

X. ROUTE FROM HUNTSVILLE TO KNOXVILLE.—The road from Huntsville to Knoxville, in East Tennessee, passes through Winchester and McMinville, both in the basin of the Tennessee River, to Sparta, on the head-waters of the Caney fork of Cumberland River, in the eastern edge of Middle Tennessee. Its course is nearly north-east, and the outlying Cumberland ridge of the Appalachian chain is most of the way in sight, to the south-east or right hand. At first, the route lies through the broad valley of Flint River, a tributary of the Tennessee. The soil of this valley is a rich reddish loam, abounding in angular nodules of chert, once imbedded in rocks, which, having suffered disintegration, form the present surface. The staple of cultivation, as in other parts of this great bend of the Tennessee, is cotton. There are both natural ponds and mill-ponds in this valley, which, like other localities of a similar kind in the south, is infested with autumnal fever.

In ascending from it, and, at the same time, entering the state of Tennessee, in north latitude thirty-five degrees, the surface of the country becomes more rolling; and a gramineous agriculture, with tobacco and pasturage,

* Western Journal, Louisville, Vol. IV, p. 1.

replaces, to a considerable extent, that of cotton. Apple-orchards also become more numerous and more productive.

After crossing the upper part of Elk River, at Winchester, the road imperceptibly attains considerable elevation, over an off-set of the Cumberland Mountain; the red cotton soil of the Huntsville plain now disappears; and the descent into the basin of Caney River, is made over a succession of beautiful terraces, called the *Pleasant Plains*, the surface of which is a yellow loam, with fragments of chert. Two springs, which burst out from ledges of carboniferous limestone rock, in north latitude about thirty-five degrees thirty minutes, had, in June, the temperature of fifty-six and fifty-eight degrees Fahrenheit. Near McMinville the red soil, with nodules of chert, reappears. From the valley of Flint River to McMinville, the country is generally dry, and appears to be but little infested with autumnal fever. From McMinville to Sparta, it continues dry, and is more broken.

From Sparta, which stands near the base of the Cumberland Mountain, the route to Knoxville is nearly east. The mountain belongs to the coal formation, and the strata which it presents on its western side are nearly identical with those of Monte Sano. A spring, about two hundred and fifty feet above its base, had, at the end of June, the temperature of fifty-five degrees Fahrenheit; another, in one of the valleys beyond the first ridge, was fifty-six degrees Fahrenheit. A succession of ridges, with intervening ravines destitute of alluvion, at length brings us into a deeper valley, which separates the Cumberland Mountain from Walden Ridge. Some of the crests passed over are, from their elevation and sterility, incapable of producing Indian corn. From the summit of this ridge, which is composed almost entirely of sandstone and conglomerate, the very distant and elevated mountains of North Carolina, in which the Tennessee has its remotest origin, can be seen in smoky outline. The descent from this mountain is into the valley of Clinch River, which is reached, over a succession of low hills, at Kingston, where it unites with the Holston to form the Tennessee River. The valley is composed of transition or Silurian limestone. It need scarcely be stated, that from Sparta to Kingston autumnal fever is almost unknown; elevation, aridity of surface, and barrenness of soil opposing its production.

From Kingston to Knoxville, on the west side of the Holston, there is no mountain, but the country is, on the whole, hilly; yet some of the valleys are of considerable breadth, and, as they rest on limestone, support a luxuriant vegetation. They do not, however, abound in ponds and marshes.

XII. KNOXVILLE is situate above high-water mark, on the right bank of the Holston, and is not surrounded by marshes. There are, however, two mill-streams adjacent to the town, one above, and the other a short distance below, which have dams and ponds. It was, doubtless, to some particular condition of these ponds, that we should ascribe the fever which, according to report, a few years since, nearly depopulated the place, and of which the history has not, I believe, been written by any of its physicians.

Previously to that epidemic, Doctor Ramsey * had read before the Medical Society at Nashville "An Essay on the Medical Topography of East Tennessee;" but he does not give us a description of the site of Knoxville, his residence, nor of any other locality.

XIII. The indefatigable state geologist of Tennessee, Professor Troost,† has shown that the whole of this region, east of Walden Ridge, consists of Silurian and other old transition rocks (chiefly calcareous), ending in the primitive. All the rivers above Kingston—the Clinch, and its large tributary, Powell's River, to the north; and the Holston, with its tributaries, the Tennessee (improperly so called), and the French Broad—may be regarded as mountain-torrents, converging to form a common trunk, the Tennessee, six hundred miles from its junction with the Ohio. Of the elevation of this sub-Alpine region above the level of the sea I cannot speak, except from estimate. It probably ranges from eight to sixteen hundred feet. But, to say nothing of the Cumberland Mountains to the west, it is surrounded from the north round to the south south-west by mountains, which attain an elevation varying from two to five thousand feet, leaving an open valley to the south-west. It is to the divergence of the Cumberland Mountains from the Appalachian group, as it advances southerly, that this great mountain cove (to borrow a term from the sea-shore) owes its existence, and constitutes a peculiar region, so well entitled to the attention of the medical etiologist.

Of this region, Doctor Ramsey, in the paper referred to, speaks in the following language: "The water-courses of East Tennessee are pure and transparent, and their currents rapid. There are no sluggish streams, and no swamps or marshes of any extent. The water is generally impregnated with lime, but springs of freestone water are not uncommon."

In reference to the autumnal fevers of East Tennessee, the same writer thus expresses himself:

"I have already observed that, during the first settlement of the country, there was generally a remarkable exemption of the inhabitants from disease. This is especially true in relation to *fevers*, properly so called. Intermittents during the period of autumnal insalubrity form an exception. These prevailed extensively; but the apyrexia being a state of comparative comfort, they received little attention, and remedial agents were rarely employed. But with the opening and improvement of the country, sources of disease have been multiplied, and with them fever has prevailed to considerable extent. It is not confined to the valleys and banks of large rivers; but the more elevated countries are annually visited with its severest forms. The fact, that fever prevails in districts where vegetable decomposition is inconsiderable, if not harmless, seems to invalidate the correctness of the theory which ascribes idiopathic fever to a miasmatic origin exclusively. I would

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* Transylvania Journal, Vol. V, p. 363. † Geological Reports.

not be understood to deny, *in toto*, that marsh miasm is the cause of fever; but since they prevail with us in a degree no way proportionate to the extent or concentration of the malaria, I must avow my scepticism of the adequacy of the cause, to the production of such extensive and powerful results. Intermittents are generally mild and manageable. Remittent fever is often violent and obstinate."

Since the publication of Doctor Ramsey's paper, another has appeared, from the pen of Doctor Cunningham, of Jonesboro,* the most eastern town in Tennessee, from which I make the following extract:

"East Tennessee, bounded by North Carolina on the east, and extending to Cumberland Mountain westward, embraces some two hundred miles in length. From the mountains on its southern border, to the line dividing it from Virginia and Kentucky, it has a medium breadth of fifty miles. It is interspersed with mountains and valleys, and every intermediate variety of surface and geological structure.

"In the highest parts of the upper counties, it presents high ridges and precipitous mountains, with a small proportion of valley, or even arable land. Here the rocky formation is principally primitive. The water is the purest freestone. The streams having rapid currents, speedily drain the soil which is almost destitute of marshes, and the dense forests and hills everywhere interpose to neutralize the action of heat in summer. Thus, miasmatic influence can hardly be said to exist at all. The atmosphere is consequently pure and salubrious, except from thermometrical and hygrometrical influence. Following the western slope, we find the country less precipitous and primitive, though still broken. Here agricultural industry has broken in upon and measurably dispersed the dense shades of the forest. The atmosphere is consequently less humid, but the country is more exposed to the scorching sun in summer, and to the bleak and chilling blasts of winter, and to the daily vicissitudes of our climate. In this region the geological structure is secondary or transition,—the water chiefly pure limestone, except on the waters of Lick Creek and Horse Creek, both of which streams collect from the southern and eastern declivities of Bay's Mountain. These streams, as well as some others, from their having percolated slate-rock, or soap-stone (which is the striking formation of that mountain, and of the region through which they pass), present constantly a muddy and impure water, unpleasant in taste, and possibly exert some influence on the health of the inhabitants, though until late years there was no marked evidence of this. The inhabitants, as far as we are informed, enjoy as good health as in other localities.

"But of late, the extensive marsh and meadow-lands bordering these streams, which were densely timbered, so as to obstruct the rays of the sun,

* Southern Medical and Surgical Journal, Aug., 1846, p. 456.

and prevent miasmatic effluvia, have been extensively cleared for cultivation. The overflowing from the heavy rains leaves pools of water, with a copious deposit of vegetable matter, which, when exposed to the summer heat, enters rapidly into decomposition. In addition to this, the sub-stratum is either slate rock, or clayey structure, through which water sinks with difficulty. It must, of course, dry up more by evaporation than by absorption; consequently, there is great increase of miasmatic influence, which readily accounts for the great increase of sickness which has prevailed there for the last few years. Still further down are some extensive plains, but the soil being porous, there is but little malaria. Yet on the rivers, affording, as they do, a greater expanse of surface, relaxed in currents, and in high tides during wet or rainy seasons overflowing their banks, they may leave standing water and a saturated soil composed of alluvial and vegetable matter. The climate is also hotter, and here may be the elements for the production of fever during seasons when their combination of causes is brought into full exercise. While it will appear that in the upper counties a large proportion of cases are fever, in their etiology they differ materially from those in the lower counties. Between the summit-level of Johnston county, imbedded in the highest mountainous region of the state, and the lowest point of East Tennessee, where the Tennessee River breaks through the Look-out Mountain, there is a difference in elevation of about one thousand feet. The mountain range bordering it on the south, recedes so as to leave the western counties of this division of the state open and exposed to the southern breezes of Georgia and Alabama, so that similar natural causes must to a good degree operate on both, and it is therefore reasonable to suppose their character of diseases would approximate each other more nearly than those of the two extremes of East Tennessee itself. But the producing causes of fever in the one, are very different from those of the other; hence we have confirmation of the (so to speak) polygeneric causes of fever; and if it be an axiom that cause and effect are steadily related to each other, it would seem fair to conclude, that a difference in kind, in development or character, and in treatment also, exists."

XIV. Comparison between East and West Tennessee.—When the lapse of time shall have put us in possession of a sufficient number of facts on the topography, climate, and endemic diseases of East and West Tennessee, to permit a full and accurate comparison, it will be found to possess as much interest as a comparison between any other two regions of the Great Interior Valley. These extreme portions of the state of Tennessee lie between the same parallels of latitude, one near the sources, and the other near the mouth, of the river which bears its name, though distant from each other about six degrees of longitude. East Tennessee has a solid basis of old crystalline or semi-crystalline rock; is hilly, rising into mountains; and has rapid creeks and rivers, with narrow alluvions, good springs, and few swamps or ponds. West Tennessee is based upon loose, crumbling, miscellaneous strata — cretaceous, tertiary, and alluvial — abounding in organic matters, and impregnated with the gases developed by their slow decomposition; has a comparatively level surface, overspread more or less with sloughs; its rivers and brooks have wide and wet alluvial bottoms, and their currents are sluggish; its springs are few, and its well-water generally impure; its elevation above the level of the sea is from a half to a fourth that of East Tennessee; and, finally, it is surrounded by plains, or low hill-lands, while the other is inclosed by mountains. The constitutions and diseases of people living under conditions so different as these, cannot, of course, be the same, although their latitudes are identical. In reference to autumnal fever, it is well known that it prevails incomparably more in the western than in the eastern locality.

XV. Voyages on the Upper Tennessee.— Kingston, at the junction of the Clinch and Holston, is the lower head of steamboat navigation on the Tennessee River; Knoxville, on the Holston, thirty miles above, is the final terminus. From the latter town to Decatur, near the Muscle Shoals, the distance is about three hundred miles. At this time the settlements from Kingston to Triana, not far above Decatur, are too limited to render the banks of the river an object of interest to the physician. Much of the region through which it passes was, indeed, until lately, the habitation of the Cherokee Indians; and much of it, in Georgia and Alabama, not less than Tennessee, is too mountainous to admit of a dense population. On that very account, however, it will be a desirable summer and autumnal retreat for the people of the hot, humid, and malarious coasts of Georgia, Florida, and Alabama; — a change of altitude near their own homes, conferring all the climatic benefits of a distant and expensive voyage to the north. In connection with this change of air, they may enjoy the voyage on the Upper Tennessee River; which may likewise be commended to invalids of the higher latitudes, when desirous, as they should be, of seasoning their exercise with the condiment of wild, sequestered, and romantic scenery. All these advantages, however, are prospective rather than present, for the number of steamboats on the Upper Tennessee is small, and the difficulty of reaching that valley, great. When it shall be penetrated from south to north by the railroads which are in progress, or have been projected, the access to it will become easy; and from the vernal equinox to the summer solstice (through which the Tennessee will be navigable), we may expect, sooner or later, to see the invalids from various latitudes united in voyages of health and pleasure on the retired waters of the mountain river. I will show the probability of this anticipation by a brief notice of a descending steamboat voyage in the month of July. Below Kingston, the river, with a general bearing to the south-west, is exceedingly serpentine. The narrow plains, down to the water's edge, were at that time clothed in a luxuriant vegetation of the deepest green, and over the wooded hills in their rear, occasional glimpses were had of Walden Ridge on the right, and the more distant and lofty peaks of Unaka Mountain, in North Carolina, on the left. Now and then the river expanded to three times its ordinary breadth, and was beautified with low, green islands, compressing the navigable channel into a canal, from the banks of which a cane-brake bent its long stems and tender leaves over the margin of the stream, while the low limbs of the overshadowing trees, drooping under the weight of their luxuriant foliage, sought relief by reposing on the clear waters. No valley could surpass the verdure and freshness of this scene; in the midst of which a grove of sycamores, towering above the lower ranges of the forest, presented a lattice-work of white limbs, which formed with the surrounding green a contrast of surpassing beauty. Continuing its course to the south-west, the river at length approaches, but does not enter, the state of Georgia. It is here, in the center of the Cherokee country, that the now abandoned missionary station of Brainerd lies, off at a short distance to the left. Then comes Ross's Landing, where the river turns directly to the south; and Look-out Mountain, blue, lofty, and precipitous, is seen a few miles ahead. To the east is the low and flat land through which the Georgia Railroad is to reach the Tennessee River, and in which branches of the Alabama River have their origin; while close at hand, to the left, Walden Ridge rises like a mighty rampart. As we neared the Look-out, the river seemed about to plunge into some deep and dark cavern beneath the rugged buttress which rose one thousand feet above us; but, after amusing itself for a moment with our bewilderment, the current wheeled rapidly to the right, and flowing for a short distance along the rocky foundations, turned still further round, and almost touched the channel through which its assault was made. Another instant brought us to a new position, and presented the side of the mountain we had just encountered, stretching far away into the state of Georgia; while before us, on the right, stood the lofty abutments of Walden Ridge, confronting, to the left, the high and rugged escarpment of Raccoon Mountain, and presenting a scene of calm magnificence and solemn grandeur, the memory of which can never fade away. In a moment we lost sight of the first, and running for a short distance along the base of the second, we entered the rent, or gap, between it and the third of these mountains, when we found ourselves in a rude, rocky gateway, with immense precipices on either side. Vast fragments had rolled down, and contracted the bed of the river to one-third of its usual width; its current was greatly increased, and huge rocks at the bottom gave to the water above that agitation which had suggested the appropriate name of 'Tumbling Shoals.' To them succeeded a pool of tranquil water; after which the mountain chasm suddenly narrowed still closer, and the whole river was poured into a deep channel not more than one hundred yards wide, down which it glided as on a smooth inclined plane. This is the 'suck' of the keel-boatmen; to which succeeded a spot where the water boiled and foamed, and then another in which the same commotion appeared in a less degree. The stream now assumed a calmer aspect, and wound its way among the mountains, by which it is so pent up, that portions of it, now and then, take on the form and face of narrow Alpine lakes. As these scenes of beauty and sublimity began to die away, we found ourselves on a wide river, still bearing to the south-west to enter Alabama, after passing within a mile of the state of Georgia. The country now assumed a more cultivated aspect, with tamer scenery; yet, blue masses of the Cumberland Mountains, lying off to our right, occasionally reminded us of the shifting scenes of grandeur through which we had passed. The last object of interest which met our view, was the precipice called the 'Painted Rocks.' Rising, like a wall, on the right margin of the river, to the hight of a hundred feet, and composed of the carboniferous limestone which forms the base of Monte Sano, disposed in horizontal layers, it displays the aspect of an immense fortification. From this point to Decatur, the low hills recede, and the river flows through bottom-lands which are liable to annual inundation.*

XVI. Southern Portion of Middle Tennessee.—About one half of Middle Tennessee belongs to the basin we are now exploring. Some account of its eastern part has been already given in the route from Huntsville to Knoxville. My personal observations on the remainder, were limited to a journey from Huntsville to Nashville, through Pulaski and Columbia, both of which lie within the basin of the Tennessee River. Doctor Buchanan, of the latter town,† has described the medical topography of this region more fully than my own opportunities would permit.

Its most important rivers are Elk and Duck. The former flows to the south, and joins the Tennessee at the Muscle Shoals; the latter holds a western course, and unites with the same tributary, as it crosses the state to the north. These rivers drain six or eight of the most populous and important counties of Middle Tennessee. Their basis is limestone — carboniferous to the south, Silurian to the north — generally covered with a thin layer of calcareous loam of a yellowish-red color, overspread with mold, which is thin on the ridges, but deep and black near the water-courses. The loose upper covering of the rocks seems to be, in a great degree, the result of their slow disintegration. No drift or transported materials are found in the district. Ponds and swamps, even of a limited extent, are but occasionally met with; and the alluvial grounds of the rivers and creeks, unlike those in the cretaceous and tertiary deposits west of the Tennessee River, are narrow, and not often inundated. In some places, the surface becomes hilly and elevated. Of the springs in this region, Doctor Buchanan speaks as follows:

"From the fact of our rock formations being all of carboniferous lime-

* This voyage was performed in company with Doctor Fearn and Doctor Breck, of Huntsville, LeRoy Pope, Esq., of Memphis, E. D. Mansfield, Esq., of Cincinnati, Mr. Tarvin, of Decatur, and several other gentlemen, all of whom had the same impression of its interest.

† Transylvania Journal, Vol. IX, No. 3.

stone, the springs are all impregnated, more or less, with lime; but they are very numerous; and, although not quite so pure and limpid as the springs of a primary region of country, are, nevertheless, cool, transparent, and refreshing. Gushing, as they do for the most part, from between two strata of rocks, or issuing from the base of a hill, their waters glide upon a rocky or gravelly bottom to the larger streams. The mean temperature of our springs, which I noticed at different times during the last year, is about fifty-eight degrees Fahrenheit. The temperature of the spring which supplies Columbia with water, was fifty-six degrees, about the first of June, when the temperature of the atmosphere was eighty-four degrees; in December it was fifty-eight degrees — temperature of the atmosphere fifty degrees; at several other times it was fifty-six degrees. Many other springs in the country were about the same; some were also as high as sixty-two degrees." *

With all these favorable topographical conditions, this region does not escape autumnal fever, the chief sources of which are the water-courses. Although most of them have bottom-lands, not often overflowed to any great extent, yet, in summer, they become insalubrious. In times of drought they fall very low, and much of their beds becomes dry. Thus they are converted into a series of stagnant pools. Many of them, moreover, are arrested by mill-dams, often at short distances from each other, above which a great deal of decomposable matter is accumulated, to be exposed to the action of the sun, as the scanty supplies of water, in August and September, are evaporated. In the latitudes of thirty-five and thirty-six degrees, at an elevation of only five hundred feet above the sea, which is that of the beds of these streams, they cannot fail to generate autumnal fever.

SECTION IV.

BASIN OF THE CUMBERLAND RIVER.

I. Outlines.—It has been already stated that this river lies in the great bend of the Tennessee River, to which, in its general course and curvature, it conforms; yet it does not wheel so far to the south as that stream; and hence, while the extremities of both are in nearly the same latitudes, their middle sections are separated a full degree. The Cumberland, much the shorter of the two, has its source in the state of Kentucky, on the western declivities of the mountain whose name it bears; whence, flowing to the west, and then to the south, it dips into Middle Tennessee, the metropolis of which — Nashville — stands on its left bank. Having passed that town, it turns north-west, and comes, at length, within a few miles of Tennessee River, when it repasses into Kentucky, and, crossing that state, joins the Ohio River at Smithland, only

* *Loco citato.*

ten miles above the mouth of the Tennessee. Thus it drains much of Southern Kentucky, and the whole northern portion of Middle Tennessee. Its sources are in the Appalachian or Cumberland coal basin; its middle in the carboniferous and Silurian limestone; its termination in the margin of the Illinois coal formation. Having laid down the outlines of this basin, let us now ascend through it to the mountains. Immediately below its mouth is the town of Smithland, of which I am unable to give a topographical description.

II. THE CUMBERLAND BASIN, UP TO NASHVILLE.—The Cumberland River, traced from its mouth up to the city of Nashville, a distance of two hundred miles, is found to make its way through a hilly and wooded country. Its tributaries are generally short; especially on the south or left side, where they are limited by the proximity of the Tennessee River, until we ascend to the neighborhood of Nashville. The bottoms along this river are much narrower than those along the rivers of the south-west, and are not as liable to inundations. The beds and banks of the Cumberland, and of its tributaries, are, in general, rocky. Within the limits of its narrow basin, on its right or north-eastern side, in Trigg and Christian counties, Kentucky, we have the western limit of a peculiar tract, called 'The Barrens,' which will be described in connection with the Green River Basin.

III. NASHVILLE, the capital of the state of Tennessee, and the only city of the Cumberland Basin, stands on the left side of the river, in N. Lat. 36° 9′ 33″, and W. Lon. 86° 49′ 3″. Its site is an elevated platform, of blue Silurian limestone, identical with that of Cincinnati. The covering of loam and soil is so thin that the rocks of the streets have to be blasted, to make receptacles for the soil necessary to the cultivation of shade-trees. Originally this terrace sustained a grove of red cedars (*Juniperus Virginiana*), of which many trees and bushes still remain. On the southern part of the town-plot there rises a beautiful rocky, oval hill, overspread with the same unerring evidence of a dry and stony soil. The surrounding country, in that direction, is calcareous and rolling. Immediately below the town, to the west, there is a depression, in which a sulphur spring bursts out, and over which the waters of the Cumberland spread themselves in high floods. On the opposite side of the river, there is a bottom of considerable extent, too elevated to be overflowed. Thus Nashville is favorably situated, as to what are regarded as the sources of autumnal fever; and its exemption from the disease appears to be in correspondence with its topography.

The surrounding country, seen from the top of Cedar Hill, presents a rugged, beautiful, and spirited panorama. In all directions it displays that configuration which excludes swamps and every variety of wet surface; but suggests ravines, with lagging streams, which, in summer and autumn, are liable to insalubrious depression.

The settlement of Nashville, by emigrants from North Carolina and Virginia, was begun in the year 1784. Hence, being one of the oldest towns in the Ohio Basin, the locality in which it stands, has passed through the transition stage from forest to cultivated field.

IV. RUTHERFORD COUNTY.—This county,* one of the oldest-settled and most important of the state of Tennessee, lies to the south-east of Nashville; from which its principal town, MURFREESBORO', is distant about thirty miles. Its basis is the blue Silurian limestone of that city, covered with a deeper stratum of loam and soil — the former a product of the disintegration of the rocky basis, the latter a result of the decomposition of the luxuriant vegetation natural to such surfaces. The aspect of this country is either undulating or level; but the surrounding country is somewhat knobby. Almost every part of it is intersected by the upper tributaries of Stone's River, an affluent of the Cumberland. These numerous streams are but scantily fed by springs; and, therefore, although flush in the rainy season, so as even to overflow portions of their narrow bottoms, they either dry up in summer, or are converted into lines of pools, which, in the language of Doctor Becton, "are loathsome and disgusting to the sight, and offensively fetid to the smell." "About seventeen creeks, forks, and prongs," he adds, "unite to constitute the main river (Stone's), which runs in a north-west course across the county. These branches and creeks rise from almost every point, and run in as many directions to the main channel. Across them are perhaps thirty-five or forty mill-dams, besides many other obstructions, made for cotton-gins and fish-traps. The ponds made by these dams are longer in evaporating than where there are no such obstructions. Near them, when the summer and fall are unusually dry, there has been more sickness than in any neighborhood of the county; except where the farmers have made watering-ponds on their plantations, for the accommodation of their stock."

Such a locality, in the latitude of thirty-six degrees north, cannot escape serious invasions of autumnal fever; which Doctor Becton has observed to be great, in proportion as a more than usually dry season reduces the water of the pools below its common summer-levels. Many cases are malignant.

V. WILSON COUNTY.—The late Doctor Hogg† has given the following summary of the topography of this county, which lies between Rutherford county and Cumberland River:

"Wilson county, containing an area of twenty-five miles square, is bounded on the north by Cumberland River, and intersected by twelve or fifteen small streams, at nearly equal distances from each other, running nearly a north course on the one hand into the Cumberland, and from south to south-west on the other hand, into Stone's River. The south south-east, and south-west sections of the country, after leaving the river ten or twelve miles, become hilly, or what we call very broken, terminating in an extensive ridge separating the small north and south streams which I have mentioned. In

* Dr. Becton, in the Transylvania Journal, Vol. V., p. 157.

† Western Journal, Cincinnati, Vol. I, p. 601.

common seasons, the small streams or creeks, from the last of July until the middle of November, become almost dry or stagnant; in consequence of which, the deposits from the previous floods are exposed to the sun during the hot weather. The soil on the high ground is rich and productive, wherever the rock does not project. The forest is luxuriant, and consists of beech, shell-bark hickory, elm, sugar-maple, walnut, and wild cherry; or of white, red, and Spanish oak, poplar, hickory, dog-wood, sassafras, and grape vines. The flat lands, which are not very fertile, are covered with oak, hickory, elm, ash, dog-wood, and cedar, with much grass and weeds."

Having given this sketch of the medical topography of Wilson county, Doctor Hogg goes on to state, that autumnal fever, sometimes of a malignant type, is one of its annual visiters.

VI. Residue of the Cumberland Basin.— On the south side of the Cumberland River, from Rutherford and Wilson counties eastwardly to the Cumberland Mountains, through the counties of Warren, White, Overton, and part of Smith and Jackson, the country is rolling or hilly, at last becoming low-mountainous, and the streams are less liable to summer stagnation; ponds are few in number, and swamps still rarer. The river can scarcely be said to be alluvial, and its bottom-lands are narrow.

On the north side of the Cumberland, from below Nashville upward to the point at which the river passes from Kentucky to Tennessee, the basin is narrow, and has substantially the topographical characteristics of the southern side. In traversing Sumner county, northwardly, from Nashville, I found it rolling or hilly, and dry, with a sub-stratum of Silurian limestone, to the margin of the adjoining basin. East and north-east of that county, the surface gradually becomes more rugged, to the Cumberland Mountain, in which the river has its sources. At what stage of this ascent up the flanks of the mountain, autumnal fever ceases, I am not informed.

SECTION V.

BASIN OF GREEN RIVER.

I. Outline Views.—The distance, along the Ohio, from the mouth of Cumberland to the mouth of Green River, is one hundred and thirty-five miles; but no town of any note stands on the left or southern bank of the river, except Henderson, with the medical topography of which I am not acquainted. The basin of Green River comprehends what is, by some, called Southern Kentucky, by others, the Green River Country, by others, the Barrens, from its embracing large tracts of undulating land nearly destitute of trees. The thirty-seventh parallel passes a little south of the center of this basin, the whole of which lies within the state of Kentucky, and belongs to the Illinois coal formation. Only the north-western or lower half, however, contains beds of coal; the other rests on the carboniferous limestone, which underlies the coal measures.

The bed of Green River for some distance up, is bordered with rich alluvial bottoms, which are not, to any great extent, subject to inundation. The river, through nearly its whole length, has been converted into pools by lock-dams, of which, in reference to their influence on the health of the inhabitants, I cannot speak.

The surface of this basin is either undulating or hilly. In some places it verges on the mountainous, especially to the north-east, where Muldrow's Hill separates it from the basin of Salt River.

The Green River Basin is comparatively free from swamps; and its narrow bottom-lands are not, in general, so low as to be, by reason of inundations, uncultivable. There are, however, two sources of autumnal fever: *First*, The pools formed in the beds of streams nearly dried up in summer; *Second*, Natural and artificial ponds, preserved or made, to afford an adequate supply of stock-water.

As, on leaving the Tennessee Basin and entering the Cumberland, we find the cultivation of cotton decreasing, and that of the *gramineæ* increasing, so, in passing from the latter into the Green River Basin, about north latitude thirty-six degrees thirty minutes, the cotton-field is no longer seen, but is replaced by tobacco and hemp.

II. The Barrens.—When treating of the Cumberland Basin, a reference was made to the region called the 'Barrens,' part of which spreads into that basin, while the remainder lies in the one we are now studying. According to Doctors Owen and Norwood,* this peculiar tract of country has for its sub-stratum the carboniferous limestone of the Illinois coal basin, overspread with a deep layer of loam, colored red with oxyde of iron, and abounding in fragments of chert or petrosilex, which were once imbedded in the rocks, whose gradual disintegration has generated the loamy covering.

I am indebted to my colleague, Professor Short, of the University of Louisville, for the following topographical description of this district.† Although his observations were chiefly made in the western part, I am assured, they are substantially applicable to the whole. The following is his account:

"When I first went to Hopkinsville, where I practiced medicine from 1817 to 1826, the aspect of the barrens was very much the same with that presented by the prairies of Illinois; and, I suppose, the characteristic feature of both — destitution of timber — is in both cases attributable to the same cause — the annual ravages of fire; which, fed by the tall grasses, and dead herbaceous plants, in autumn, is so intense as to destroy all the ligneous growth which may have sprung up during the preceding spring and summer. The vegetable productions of both these regions — barrens and prairies —

* Researches among the Prot. and Carb. Rocks of Central Kentucky.

† MSS. *penes me.*

are very similar; the grasses being, for the most part, various species of *Andropogon* and *Panicum*, and the herbaceous vegetation consisting, chiefly, especially in autumn, of the various *compositæ—Silphium*, *Aster*, *Solidago*, *Eupatorium*, &c.; while along the water-courses, in both regions, the arborescent species are very much the same; as they are, also, in certain woodland tracts, called by the people 'groves.' This difference, however, obtains, between the barrens of Kentucky and the prairies north of the Ohio, viz, that the former are superimposed on a bed of limestone, which is wanting in Illinois. The limestone of the barrens, too, is of a peculiar kind, and very different from that of northern Kentucky. Instead of being regularly stratified, or disposed in horizontal layers, it seems amorphous and irregular; generally found at very different depths beneath the surface, and covered with a red, tenacious clay containing chert, or else projecting above the surface in misshapen blocks. This limestone, moreover, is exceedingly cavernous; and 'sinks,' or depressions, are frequently met with, which lead to apertures in the rock. Indeed, in many parts of this district, large streams disappear from the surface, take subterranean courses for miles, and again emerge into day. The barrens of Kentucky are, moreover, much more rolling, and uneven on their surface, than the prairies of Illinois; and you nowhere meet with those extensive tracts of level surface, so common in the large prairies of that state. By cultivation, and the prevention of destroying fires, the barrens are losing, yearly, their once peculiar features; for, no sooner are the fires kept out for a few years, than the surface becomes clothed with a dense growth of timber — oaks and hickories — so dense, indeed, as to stifle entirely all herbaceous undergrowth.

"*Marshes*, in the proper sense of that term, are exceedingly rare among the barrens. Indeed, within the limits of the three counties in which I practiced — Christian, Todd, and Trigg — I know of but one marsh of any magnitude; and that I shall never forget, from the circumstance of finding in it the *Cyamus luteus*, the most magnificent of all aquatic plants. Around the margins of this marsh, in the shallow, muddy water, were growing thickets of *Decodon verticillatum*, *Cephalanthus occidentalis*, *Rosa Carolina*, and other semi-aquatic shrubs.

"The streams, in the western part of the barrens, run in deep rocky beds; the banks being often precipitous, and ten or twenty feet above the ordinary level of the water; thus they rarely overflow their narrow bottoms. In fact, I do not know any part of that region which is inundated, except it be where the streams have been dammed for the erection of mills. There is, however, another source of marsh effluvium, that, no doubt, exerts a material influence on the health of the inhabitants; which is, the number of ponds, some of them natural, but many more artificial, which are found throughout the barrens; for no sooner are the apertures in the limestone closed, either by accident or design, than the 'sinks,' surrounding them become filled by rains; and the tough, red clay preventing all percolation, these ponds continue steadily to increase in area and depth, until, if not drained, they rise to the surrounding brim. In this way are these ponds constantly forming; and there is scarcely a farm to be found in the whole region, where a number of them do not exist, some to the extent of several acres. They are subject, of course, to various fluctuations, and expose a large surface of mud, as they dry up, in times of drought. The running streams, moreover, become very low, in the latter part of summer and in early autumn; but, as before observed, their beds being rocky, they are comparatively harmless, except where they are obstructed by dams.

"During the nine years that I resided at Hopkinsville, there was every year a very general prevalence of autumnal fever; beginning, commonly, in July, and continuing to October. The worst cases wore an obscurely-marked intermittent form, attended by deep congestions of the viscera. They sometimes extended far into winter."

I am informed by my colleague, Professor Yandell, who has lately visited the barrens several times on geological explorations, that the fevers of autumn are annually increasing; which he ascribes to the increase of ponds. Thus while the common, the legitimate influence of settlement and cultivation, is to abate the frequency and violence of our intermittent and remittent fevers, here, as an exception, is a district in which art has, undesignedly, contributed to their greater prevalence.

I shall extend this article no farther than to add, that the barrens extend westwardly, from near Glasgow, in Barren county, through Edmondson, Warren, Butler, Logan, Todd, Christian, and Trigg counties, to the Cumberland River, and embrace the towns of Bowling-Green, Russellville, Hopkinsville, and several others of less note.

III. THE MAMMOTH CAVE.—The barrens and the basin of Green River enjoy the distinction of including the celebrated Mammoth Cave, the most remarkable of the numerous caverns in which the limestone immediately beneath the Illinois coal formation abounds. The interest of this cave is not, however, to etiology, but to practical medicine; for it does not cause diseases, and has been proposed as a residence for their cure. It may, therefore, receive a notice in this work, with the same propriety that certain salubrious localities and regions for travel have been indicated.

The Mammoth Cave consists of a labyrinth of subterranean cells, united by winding apertures, corridors, and broad avenues, in which the traveler may wander an indefinite distance, without threading all its mazes. Indeed, as the carboniferous limestone is essentially cavernous, it is extremely probable that all its cells are connected with each other, and that subterranean journeys might be performed throughout the whole tract of country called the Barrens. Some apartments of this cave are small; others of a breadth and hight eminently fitted to raise emotions of wonder and sublimity in the visiter, whose torch throws a dim light on rocky ceilings more than a hundred feet above his head. Stalactites, alabasters, and crystallized gypsums, as white and variegated in form as flakes of snow, decorate the slowly-decaying walls of other apartments; while streams and pools of pure water are animated with fish, whose eyes, from the utter darkness of their habitation, have not been perceptibly developed. The atmosphere of this labyrinthine excavation, is said not to be damp to the feeling; but I have not met with any observations on its dew-point. Various processes of natural chemistry, perhaps, absorb the moisture of the air, and convert it into the water of crystallization. Besides the formation of crystalline carbonate and sulphate of lime, the nitrate of lime is constantly generated; out of which salt-petre was formerly manufactured, by the aid of wood-ashes.* These caverns, at the time the rocks were deposited, were probably filled with soft or decomposable materials; which have since been dissolved or washed away; but the work of enlargement is doubtless still going on, by the slow conversion of their walls into nitrate of lime, a soluble salt.†

The temperature of the deeper parts of the cave, is said to be fifty-nine degrees Fahrenheit, throughout the year.‡ In winter, a current of air descends into the cave; in summer, escapes from it; often with such velocity as to extinguish the lamps of those who are entering. This is apparently the only mode in which the external atmosphere modifies that of the cavern. The air of the cave has not been analyzed. Its sensible qualities are simply those of freshness. No difficulty of respiration, or headache, is produced by the atmosphere of any apartment, and the lights which visiters carry burn brightly in every part. Hence, we see, there is no addition of carbonic acid gas, or other mephitic air. Dead animal matter does not become putrid, but undergoes desiccation. There are no reptiles of any kind. Neither light nor sounds make their way into the deep recesses. They who have visited this great excavation, speak of wandering and clambering for a whole day without fatigue. They regard the atmosphere as invigorating. It may be that it holds saline substances in solution, which, entering the blood by the lungs, favor its aeration, and thus ward off the fatigue of exertion; or the mental excitement may support the strength of body.

When salt-petre was manufactured there, it was observed that the health of the operatives was excellent, and that many 'ailing' or 'weakly' persons became sound in health, and experienced increase of flesh. The oxen, also, that were employed, not only continued in good health, but became fat. With these facts before their eyes, the people near the cave have long believed that it might be made an advantageous abode for invalids, especially those affected with pulmonary diseases, as they would escape all vicissitudes of temperature. It was not, however, until within the last few years, that cottages were erected, and sick persons publicly invited to make it a place of resi-

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* Doctor S. Brown, in Transactions of American Philosophical Society.

† Western Journal, Louisville, October, 1847.

‡ Rambles in the Mammoth Cave, 1844.

dence. This enterprise was undertaken by Doctor Croghan, of Louisville, who, having become its proprietor, was sanguine in the anticipation that it might be made signally beneficial to consumptive patients. Some experiments have been made, but the results, I believe, have not been encouraging. The mere seclusion of a patient from the changes of the weather, is not a positive influence, and by no means to be relied upon to arrest a malady which may occur independent of such vicissitudes. Then the solitude and silence, the darkness, the smoke, the atmospheric repose — for the wind is perceived only at the entrance — the want of exercise, the absence of many other exciters and sustainers of our mental and bodily activity, are counteracting agencies, not to be forgotten in a candid estimate. To render a sojourn in these subterranean cells effective in the removal of diseases, the patients should have occupation, like those who once made salt-petre there; and to recommend such an abode to those who are too ill to labor, and are in need of medication, would seem injudicious, if not absurd. To what forms of chronic disease such a residence is, in fact, best adapted, cannot, I think, be determined *a priori*. I would conjecture, however, that chronic bronchitis, and functional disorders of the stomach, bowels, liver, and spleen, would be more certainly relieved than any others. To these I would, conjecturally, add subacute ophthalmia, obstinate ulcers, and other chronic affections of the skin. As to phthisis, if the patient could engage in hard labor, and the tubercular transformation of his lungs had not advanced very far, it might, perhaps, be arrested; but if he had reached the latter stages of the disease, he would do well to remain at home.

A more favorable opinion may be given of visits to the cave, than of a constant residence in it. As a place of resort for invalids who require exercise, with change of scene, it has much to recommend it; for its 'wonders are past finding out,' and, for several weeks, an inquisitive invalid might find exercise and interest in threading its labyrinths, while the weather was either too cold, or too hot, or too wet to admit of his taking adequate recreation in the open air. To all such it may be announced, that the munificent proprietor has taken care to provide comfortable, and even elegant accommodations, near the portals of the cave.

SECTION VI.

THE LEFT BANK OF THE OHIO, FROM GREEN RIVER TO SALT RIVER: BASIN OF THE LATTER.

I. The River. — The length of this portion of the Ohio River is about one hundred and sixty miles. In ascending it, we cross the thirty-eighth parallel of latitude. The general character of the bed and banks of the river is the same that was set forth at large in Section II of this Chapter. At several points the river has cut through beds of coal; it also traverses the underlying carboniferous limestone, which, in certain places, presents mural precipices, bearing red cedars. As we advance upward, the second bottoms become more elevated, and the lower alluvial lands are rather less subject to inundation. In Hancock county there is an expansion of the river-bottom to the width of seven miles.*

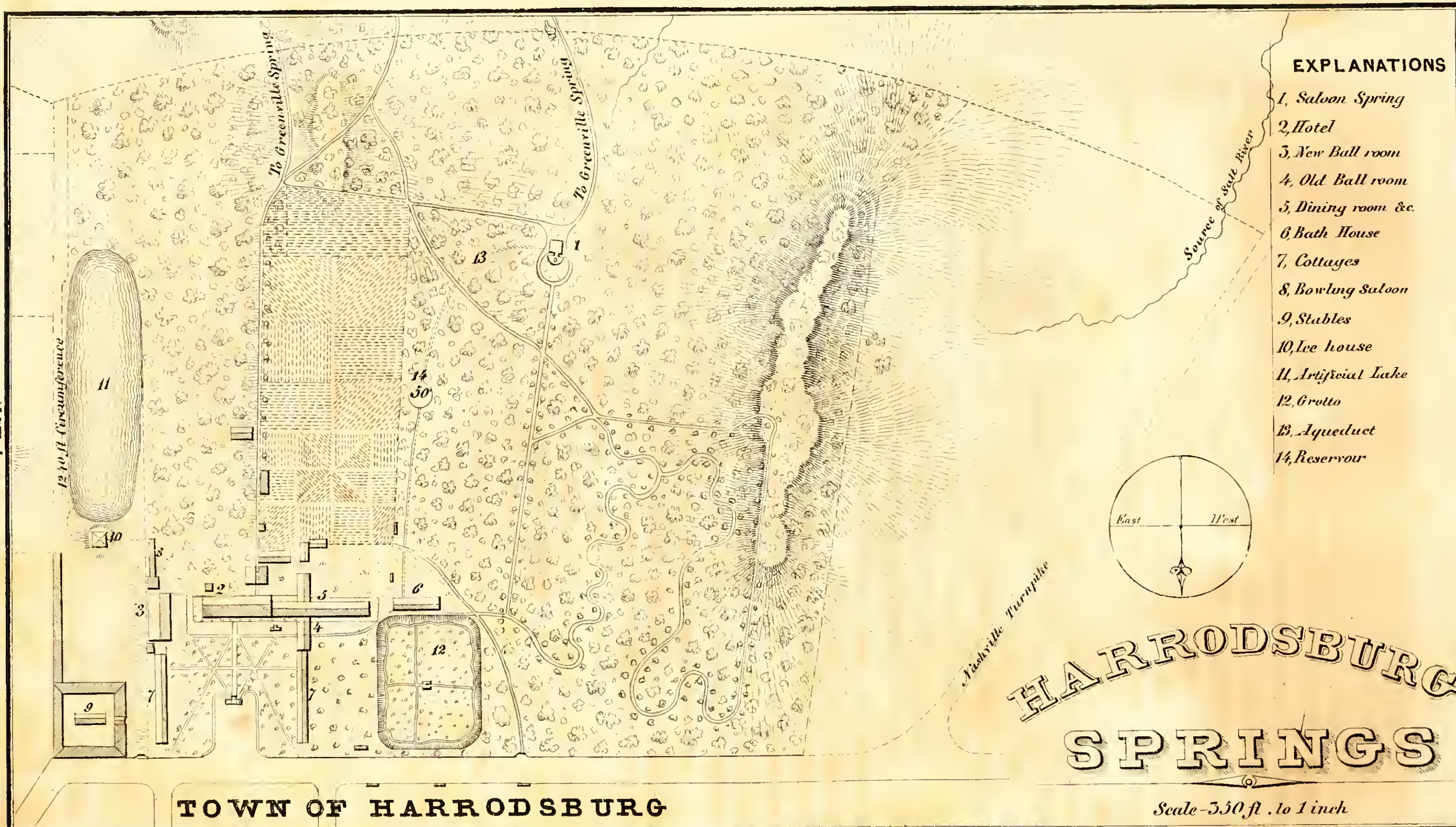
There are several thriving villages on this bank of the river, of which Hawesville, where coal is dug, is the most noted. The whole, together with the country between them, are subject to intermittent and remittent fevers, but not to such a degree as to retard their growth or prosperity.

II. Basin of Salt River. — The breadth of this little basin, unlike that of most through which we have traveled, is quite equal to its length. The river consists of two principal branches. The southern, bearing the name of Rolling Fork, interlocks to the south with the waters of Green River; the northern, known as Salt River, has its origin between the Kentucky River and the Ohio. Their union is but a few miles from the junction of the common trunk with the Ohio, twenty miles below Louisville. Salt River proper, or the northern branch, has all its head-waters in an out-crop of the upper Silurian limestone, which emerges not far above Louisville, and extends to the Kentucky River at Frankfort. This region presents ravines and low winding ridges, having a fertile soil, with tolerable springs and very few marshes. But, as in the other basins where the geology is the same, the streams sink in summer and autumn into pools, and the country is not exempt from fever. The Rolling or southern Fork has its origin mainly in the carboniferous limestone of the adjoining Green River Basin; and much of the surface which it drains is hilly; some parts low-mountainous. The immediate valleys or troughs of both forks of Salt River, present a considerable extent of bottom-land, which, with that along the common trunk, is occasionally inundated. Fevers, often malignant and fatal, prevail along these streams, especially low down, where their common valley opens into that of the Ohio.

III. Harrodsburg Springs.—These springs belong to the basin now under examination, being situated near the sources of Salt River. Unlike most of the mineral springs of Kentucky, which are found in deep valleys, these burst out near the summit-level of the country, at an altitude of near a thousand feet above the Gulf of Mexico. From near the springs, small tributaries of the Kentucky River and of Dick's River flow off to the east and north, and those of Salt River to the south and west; a sufficient evidence of the relative elevation of the spot where they are found. In every direction, for several miles round, the country is as free from drowned lands, marshes, swales, and ponds, as any other equal area in the Ohio Basin. In fact, there does not seem to be a single source of malaria in their neighborhood; and my colleague, Professor Miller, who practiced medicine nine years in this locality,

* Collins's Kentucky.

PL. X.



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has assured me, that intermittent and remittent fevers are far less prevalent here than in the Barrens.

The town of Harrodsburg, in the suburbs of which we find the springs, was the first-settled spot in the state of Kentucky; and consequently the soil has been under cultivation since the month of June, 1774; that is, nearly seventy-five years; a period quite sufficient to diminish those elements on which autumnal fever remotely depends. I am the more careful to set forth these facts, because most of the watering-places in the West, from being in valleys, are scourged in August and September with bilious fevers; and because the invalids of the South-west, especially those who have been made such by its fevers, cannot have their constitutions repaired by sojourning at springs which are situated in malarious localities.

Harrodsburg Springs are not only in the oldest-settled spot in the valley of the Ohio, after Pittsburgh, but they issue from strata which, I am informed by Professor Yandell, rest upon the very oldest formations known in the Ohio Basin. Considered in reference to chemical character, they are magnesian limestone.

Desirous of publishing an accurate account of the composition of these waters, I desired Doctor C. H. Raymond, of Cincinnati, to visit and analyze them; which he did in the month of October, 1848, selecting the two fountains from which invalids are chiefly supplied. The following are the results with which he has furnished me:

THE GREENVILLE SPRING.

Ingredients in a pint of the water, stated in grains and hundredths, Troy.

Bicarbonate of magnesia, - - - - - - -	2.87
Bicarbonate of lime, - - - - - - -	0.86
Sulphate of magnesia (crystallized), - - - - -	16.16
Sulphate of lime (crystallized), - - - - -	11.06
Chloride of sodium, a trace.	30.95

THE SALOON, OR CHALYBEATE SPRING.

Quantity of water the same.

Bicarbonate of magnesia, - - - - - - -	0.43
Bicarbonate of lime, - - - - - - -	4.31
Bicarbonate of iron, - - - - - - - -	0.50
Sulphate of magnesia (crystallized), - - - -	27.92
Sulphate of lime (crystallized), - - - - -	10.24
Chloride of sodium, - - - - - - -	1.20
	44.60

The bicarbonate of iron in this spring is sufficient to impart to its salts a light fawn-color. The water of both springs is limpid. Doctor

Raymond could not detect either free carbonic acid or sulphureted hydrogen gas.*

It will be seen by these analyses, that every tumbler of the water of the Greenville Spring contains within a fraction of sixteen grains of saline matter, more than half of which consists of magnesian salts; that every tumbler of the water of the Saloon Spring contains twenty-two grains of saline matter, two-thirds of which are sulphate, with a small quantity of bicarbonate, of magnesia; and that in the same quantity of the water there is a quarter of a grain of iron. The patient, who in one morning drinks four tumblers of the water of the Saloon Spring, takes nearly a drachm of sulphate of magnesia, with other saline ingredients, and a grain of bicarbonate of iron.

I shall follow these estimates no further, but proceed to say, that the water of the Greenville Spring is the better antacid—that of Saloon, the better tonic. Indeed, small as the quantity of iron is, it sometimes produces an uncomfortable feeling in the head, which is relieved by drinking at the other fountain. In reference to the excretions, the water from both acts upon the bowels, kidneys, and under proper regulations at night, upon the skin. Beyond these sensible effects, it pervades the whole constitution, and many classes of invalids very soon feel a renovation of appetite, strength, and cheerfulness, although its primary effects seem to be sedative, not stimulant. I transcribe from the article in the Journal already quoted, the following remarks on the curative effects of these waters:

"The cases to which they are, in a peculiar manner, adapted, are chronic inflammations, and obstructions in the abdominal viscera. Thus, they are

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* In the year 1823, while attached to the medical department of Transylvania University, assisted by my ingenious and lamented friend, the late Doctor Robert Best, adjunct to the Professor of Chemistry, I made a *qualitative* analysis of the water of the Saloon Spring; which has ever since been before the public. (See West. Jour. of Med. and Phys. Science, Cincinnati, June, 1828.) A want of faith in its accuracy, led me to propose a new analysis, by a much abler hand. The results then obtained were the following:

Carbonate of magnesia, - - - - - - -	in a small quantity,
Carbonate of lime, - - - - - - - - -	" minute "
Sulphate of magnesia, - - - - - - -	" large "
Sulphate of lime, - - - - - - - - -	" small "
Sulphate of soda, - - - - - - - - -	" " "
Iron (probably in the state of a sulphate), - -	a trace
Sulphureted hydrogen, - - - - - - -	in a minute "

It will be observed, that this analysis and that by Doctor Raymond give nearly the same ingredients; and both nearly correspond with one made subsequently to mine by Professor Yandell. (Transylv. Jour.) Doctor R. has more properly regarded the carbonates as bicarbonates, and ascertained that the iron is a salt of that kind, instead of a sulphate; he likewise found the soda to be combined with hydrochloric acid, instead of the sulphuric; finally, he could not detect any sulphureted hydrogen; which may, perhaps, sometimes be present in minute quantities, and sometimes absent. In his examination, subsequent to my own, Professor Yandell detected that gas in small quantities.

eminently serviceable in such cases of dyspepsia as are attended with subacute gastritis; in almost every kind of hepatic disorder, except when the liver is indurated, and, consequently, incurable; and in constipation, so constant an attendant on diseases of the stomach and liver. They are almost equally beneficial in chronic inflammations of many other parts of the system — especially of the serous and fibrous membranes. In tonic dropsies, in rheumatism, and in various affections of the periosteum from febrile metastases, from syphilis, and from mercury, they have often effected a cure, when other means had failed. In several urinary disorders they have done equal good. In chronic diseases of the skin they have also been found useful, when the patient has been subjected to a regimen that has determined them to the surface. In pulmonary complaints they have been found serviceable; but not in the same degree as in disorders of the abdominal organs; and their use in those maladies requires discrimination. In chronic pleurisy, and the early stages of subacute bronchitis, they have performed cures; but in vomica, tubercular suppurations, and hepatization of the pulmonary tissue, they are injurious, and, if persevered in, may even prove fatal. When they have rendered occasional assistance in these affections, it was chiefly by correcting a morbid condition of the digestive functions, so often associated with them. In sick headache they occasionally do good; but many cases of that obstinate malady are attended with such an enervated condition of the nervous system, that their sedative operation becomes prejudicial."

The experience of multitudes, since these remarks were published, twenty years ago, has, in the main, confirmed their accuracy, and even added to the catalogue of maladies which have been palliated or removed.

The Harrodsburg waters have, by exportation, been extensively distributed over the South-west, and even found their way into use in several of our garrisons. The salts obtained by their evaporation have long been employed by the people, and also by many physicians, who have found them more efficacious than the officinal sulphate of magnesia.

It is proper to say something of what art has done to make this an acceptable residence to the infirm, and to the friends who may desire to accompany them. To this end, the enterprising and courteous proprietor, Doctor Christopher Graham, through a period of twenty-five years, has devoted himself, with a liberality only equaled by his taste and diligence. Within that period, his permanent expenditures have exceeded two hundred thousand dollars, and he is still inventing new means for comfort, amusement, and the beneficial use of the water; among which are baths, both cold and warm, the latter of which, from the high degree of saline impregnation, cannot but prove valuable in a great variety of cases.

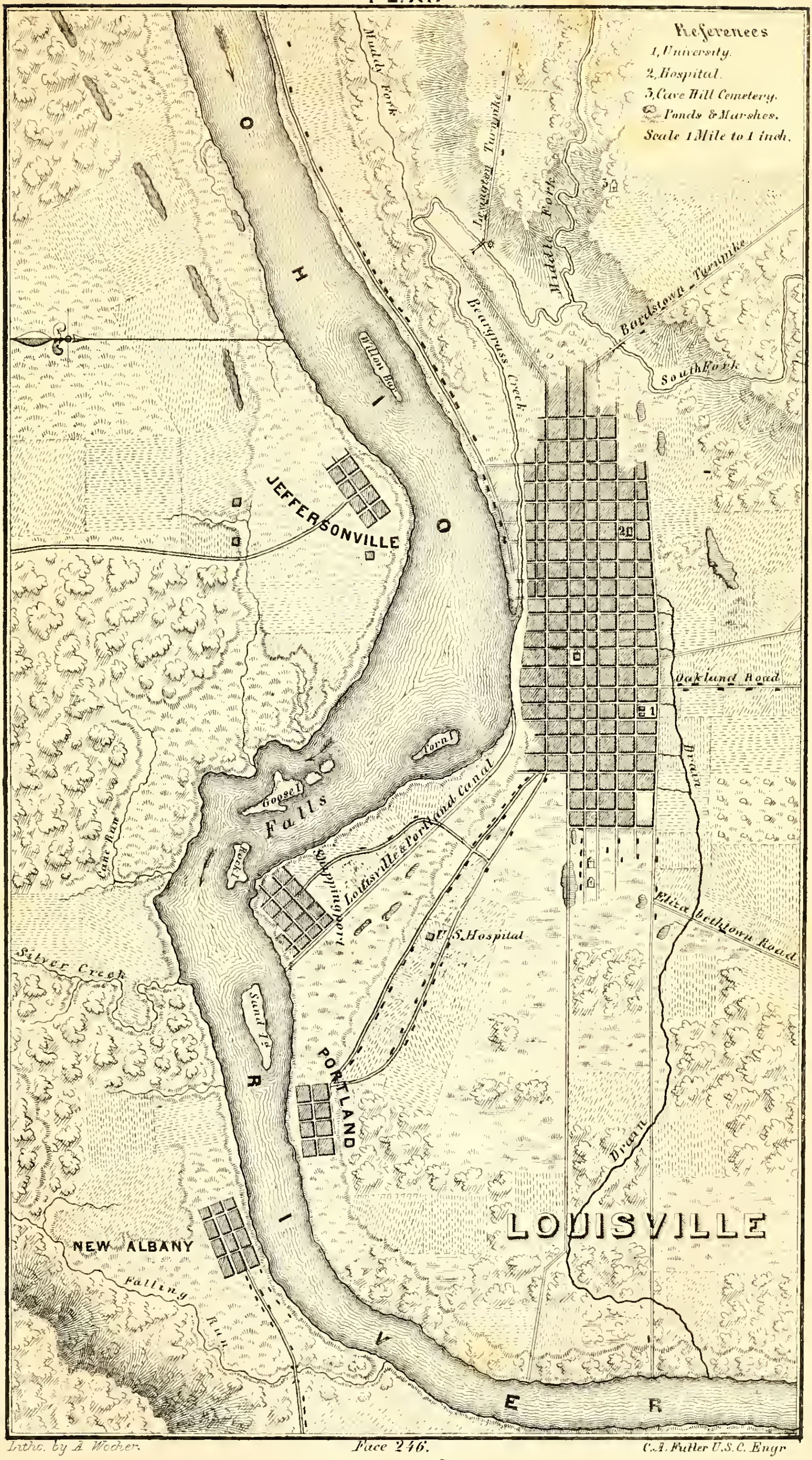
A topographical map (*Pl. X*) of the grounds around the principal spring, including the various improvements, has been made at my request, by Captain Fuller, Topographical Engineer, the inspection of which will render a description of them unnecessary; and I need only say, that while the waters are perhaps adapted to as great a variety of infirmities as any now in use in any country, the accommodations which have been created will, from the reports of travelers, bear an advantageous comparison with any to be found either in America or Europe. Such is the spot which, in the midst of a highly cultivated society, may be added to the wild scenes on the Tennessee River, the Mammoth Cave, the Upper Mississippi, and the Great Prairies, already recommended as places of beneficial resort for various classes of invalids.

But the attractions of the Harrodsburg locality are not confined to its medicinal waters and its munificent accommodations; for, although it lies in a region of fertile and gently rolling country, which would seem to promise nothing rare or romantic in nature, it is by no means destitute of objects and scenery which the eye of taste must regard with the deepest interest. About fifteen miles to the south-east are the 'Knobs,' where, on a plain, the basis of which is the black or Devonian slate, may be seen a scattered and picturesque group of slate-clay pyramids, or rude, truncated cones, rising from one to two hundred feet in hight. At a less distance to the east, is the gorge through which Dick's River precipitates itself into the Kentucky. Lastly, at the distance of eight or ten miles to the north, the beholder finds himself on the verge of a chasm, as deep, and dark, and wild, as that of Niagara below the Falls. In this profound ravine, with walls of the oldest transition marble, and a garniture of mingled evergreen and deciduous forest trees, the Kentucky River quietly winds its way, and, by its very repose, seems to say that its work of excavation is finished.

SECTION VII.

FALLS OF OHIO—LOUISVILLE.

I. TOPOGRAPHY.—In ascending the Ohio River from the mouth of Salt River to the Falls, the course is but a few degrees east of north—the distance about twenty miles. In traveling from one point to the other by land, the journey is over a plain, the elevation of which is above high-water mark, and its breadth from three to five or six miles. From every part of this plain, which extends to the river on the west, the blue range of Silver Creek Hills may be seen, running parallel with the river on its western or right side, while a lower range, called the 'Knobs,' is seen to terminate the plain on the opposite or eastern side. Thus between Salt River and the Falls, there is an ample terrace, elevated nearly as high as the second bottoms of the river, already described in Section II of this Chapter. It cannot, however, in strictness, be classed with those deposits, which, generally sloping back toward the hills, and composed largely of gravel, pebbles, and bowlders, retain but little water on their surface; while this, although it presents many beds and ridges of sand or sandy loam, so abounds in clay, that the



Litho. by A. Wocher. Face 246. C. A. Fuller U.S.C. Engr

rains are but slowly absorbed, and, at the same time, it is so level as to prevent their readily flowing off. Thus, in times long gone by, they accumulated in the depressions on its surface, and overspread it with ponds and limited elm and maple swamps; which dry up in summer and autumn, but at other seasons send out small streams that make their way into Salt River, and into the Ohio, both above and below the Falls. The middle and southern portions of this plain, where the natural cisterns were, and still are, of greatest extent, is called by the ominous name of the 'Pond Settlement.' The area of the entire plateau cannot be less than sixty square miles; the whole of which lies to the summer-windward of the city of Louisville, which is built on its northern extremity, opposite to and above the Falls. The site of the city itself was swampy, with shallow ponds, and although more than seventy years have elapsed since the commencement of settlement, specimens of both may be seen within two miles to the south and west of the city quay; for the draining of which a trench has been dug, as may be seen in *Pl. XI.* Even the streets of the southern suburbs, show a soil retentive of moisture and disposed to swampiness, while the surface is so level as to render all draining difficult. To the south-east of the city, the creek called Beargrass descends from the higher lands, and being joined by streams which originate on the plain, flows to the north along the base of the low hills, until it reaches the river-bottom, when it turns to the west, and, like a narrow canal, makes its way for a mile nearly parallel to the river, which it finally joins at the middle of the northern margin of the city. The water in the estuary of this creek is generally foul and stagnant; and the slip of bottom between it and the river is sometimes overflowed. A quarter of a mile from the mouth of Beargrass, opposite the lower part of the city, is the head of the Louisville and Portland Canal, which, after running two miles, enters the Ohio below the Falls. The bed of the canal is in solid rocks, the removal of which has given it high and stony banks; but on each side, and especially between it and the river, after the first mile from its head, the bottom is so low as to be subject to annual inundation. On this bottom, immediately above the junction of the canal with the river, stands the old, declining village of Shippingport. Below the junction, on a bank so high that even its most depressed portions are inundated only by the greatest floods, is the newer and more growing town of Portland; in the rear of which, to the south, there are many small ponds and swamps, situated on the upper terrace.

II. Geology of the Falls.—Reference has been already made to a range of hills on the western side of the Ohio. Their altitude is between five and six hundred feet above low-water mark. They constitute the final out-crop, to the east, of the fine-grained sandstone, with beds of limestone, which underlie the Illinois coal basin. At the base of these hills there is an out-crop of black or Devonian slate, and from beneath it the limestone of the Falls emerges. This limestone, as Doctor Shumard informs me, belongs to the Devonian group, but is far harder and more indestructible than the slate which rests upon it. With these facts before us, the explanation of the production of the Falls is not difficult. Flowing over the limestone from the east, and reaching the softer slate, the water would excavate it more rapidly, and very soon a descent from one formation to the other would be established. The depth of this descent is probably still on the increase. The entire fall at this time is twenty-five feet nine inches. Above the rapids, the extreme rise of the river, from low to high-water, is forty feet two inches; below, sixty-four feet five inches.* The general level of the great terrace on which the city stands is twenty-four feet above high-water mark, which being four hundred and seventeen feet above the sea, makes the elevation of the Louisville plateau four hundred and forty-one feet.

After the few words which have been said on the geology of the Falls, the explanation of the origin of the plateau which has been described, will be easily made. The spot it occupies was once covered by a deep bed of black slate, which has been washed away or decomposed, and left, in part, to constitute the present materials of the plain; and, like those left by all disintegrated slates, they abound in argillaceous matter, which prevents the rains from sinking into the earth, and thus swamps and ponds are generated.† Had an equal amount of sandstone been decomposed, a dry and sterile plain would now occupy the place of that which has been described. Thus it is that geology illustrates topography. In most parts of this plateau, excellent hard water is obtained by sinking wells.

III. THE CITY OF LOUISVILLE is in N. Lat. 38° 3′, and W. Lon. 85° 30′. Its position in reference to the river, the Falls, the estuary of Beargrass, and the pondy terrace to the south, may be seen in *Pl. XI.* In former times, a large portion of its dwelling-houses were built with basements above the ground, to avoid the dampness of the surface. The change in that fashion, which is going on, indicates the progressive drying of the soil. The houses are chiefly of brick. Several of the streets are unusually wide. No parts of the city are very compactly built. Its spread has been up and down the river, much more than from it, as the swales and ponds in its rear have limited its extension in that direction. The descent of the streets near the river is such as to admit of successful drainage; but, at the distance of a few squares from the bank, the levelness is so great as to interfere materially with the discharge of the contents of the gutters into the sewer which has been dug behind the town, the outlet of which is into the Ohio some distance below the Falls. The fuel of the city, formerly wood alone, is now chiefly coal. It has no hydrant system, and well-water is in universal use. Its manufacturing establishments are not sufficiently numerous and extensive to merit the attention of the etiologist, with the single exception

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* Colonel Long, U. S. Topographical Engineer, MSS. *penes me.*

† Contributions to the Geology of Ky. By Doctors Yandell and Shumard.

of hemp-carding and spinning. Louisville was originally settled by emigrants from Virginia, but at the present time its population includes people from most of the states, and also from various kingdoms of Europe, of whom the Germans are the most numerous.

IV. Autumnal Fevers.—From the earliest period of its settlement, the whole plateau, from the Falls to Salt River, has been infested with autumnal fevers, intermittent and remittent, simple and malignant. They still prevail, but wherever clearing, cultivation, and draining have extended, they have signally diminished. Some portions, however, have repelled those who, settling upon, might have transformed them, and still remain unreclaimed. Louisville itself offers a beautiful example of the influence of civic improvements, in destroying the topographical conditions on which these fevers depend. For a long time, when its population was small and scattered, its streets unpaved, and its out-lots overspread with small swamps and shallow ponds, the annual invasions of autumnal fever were severe; and in 1822, a sickly year over the West generally, it was scourged almost to desolation.* With increasing density of population, however, and the consequent draining, cultivation, and drying, a great amelioration has taken place; and fever, especially the intermittent form, is now a rare occurrence in the heart of the city; but as we advance into the suburbs, the disease increases. Thus a difference of a few squares, gives a striking difference in autumnal health.†

To the east, the people on both sides of Beargrass are peculiarly subject to fever; and to the west, those of Shippingport, situated, as we have seen, in a low river-bottom, are equally liable.

SECTION VIII.

BASIN OF THE KENTUCKY RIVER.

I. Ascent of the Ohio River.—The distance from the Falls to the mouth of the Kentucky River, is sixty-two miles; the course, in a direct line, nearly north-east. The river-bottoms, on the left or Kentucky side, do not present any important town, or any remarkable locality. The hills at first are low, but rise gradually, and are composed of the Devonian limestone, which emerges at the Falls; to which succeed out-crops of upper Silurian, or gray cliff, and then lower Silurian, or blue shell limestone. Immediately above the junction of the Kentucky with the Ohio stands the old village of Port William, now called

II. Carrolton.—The extensive bottom on which it is built, consists of a narrow terrace along both rivers, liable to spring inundations, and a higher and broader plateau, which in the rear is depressed, and was formerly a

* J. P. Harrison, M. D., in the Phil. Jour.

† Contributions to the Geol. of Ky. By Doctors Yandell and Shumard.

swamp, covered with semi-aquatic shrubs and herbaceous plants. By ditching and destroying the natural vegetation, this tract of forty or fifty acres is now dry and reduced to cultivation. From Doctor Mason, my authority for this fact, I learn that formerly the people living adjacent to this swamp suffered greatly from fever, especially intermittents, which even overspread the village; but since the abatement of the paludal nuisance, the disease has almost disappeared, notwithstanding the shores of the two rivers remain nearly in the condition in which they were when the disease prevailed.

III. General Character of the Kentucky River.—From the sources of this river in the Cumberland Mountains, to its mouth, the direct course is nearly north-west; but it does not flow on that line. For the first half of its length it runs nearly west; through the second half, almost north. In ascending it, for the first thirty or forty miles the bottoms are of such width as to admit of cultivation, and, in general, so elevated as not to be overflowed. These bottoms gradually narrowing, the opposite hills approach each other, and, before we reach Frankfort, the capital of the state, present a ravine with mural precipices; a conformation which continues for a great distance, and has been already pointed out in treating of the Harrodsburg Springs. Beyond this ravine, the upper parts of the river are found among the flanks of the Cumberland Mountains, in the Appalachian coal formation. The lower strata found in the walls of the ravine, belong, as I am assured by Doctors Yandell and Shumard, to the oldest limestone met with in the southern Interior Valley, as it underlies the blue Silurian limestone of Natchez and Cincinnati. Of course, except near its mouth, the alluvial grounds of such a river can present nothing of interest to the medical topographer; but the river itself deserves attention. The fall through its lower half is so inconsiderable, that the high floods of the Ohio River exert an influence as far up as Frankfort, seventy-five miles. From this approach to a horizontal bottom, the river formerly presented, in summer and autumn, a series of pools and ripples, from the margins of which exhalations arose which generated autumnal fevers. A few years since the state of Kentucky constructed a series of dams and locks, which have created a slack-water, navigated for the distance of nearly one hundred miles. Thus, the river, except when in flood, presents a series of long and deep pools, which do not sink so low in times of drought as the natural pools, and consequently there is less exposure of foul margins to the sun.

Anxious to ascertain the effect of this change in the condition of the river on autumnal health, I wrote to Doctor Drane, who resides in Newcastle, a few miles from its left bank, and his reply was that it had not increased the annual sickness. I also wrote to Doctor W. C. Snead, of Frankfort, who answered the question as follows: "The slack-watering of the Kentucky River, has very materially improved the health of the people living along its banks. The old-fashioned fevers have almost entirely disappeared, and settlements that were once considered very unhealthy in autumn, are nearly exempt from the epidemics under which they suffered. I have paid special attention to this subject for the last seven years, and feel fully satisfied that the facts above stated are correct." Doctor Mason, of Carrolton, however, has informed me, that the people who reside along the first pool formed by a dam, only two miles from the mouth of the river, have been more affected by autumnal fever than before the erection of the dam. These discrepancies are resolved by referring to the character of the banks of the river. Opposite the first pool they are broad; where the observations of Doctor Doane were made, they are much narrowed, and at and above Frankfort they are narrower still. Where the bottoms are widest the dams have done harm; where narrowest, good; where intermediate, they seem not to have produced any effect on health.

IV. FRANKFORT.—The bottoms of the Kentucky River are so narrow, that throughout its whole length there is not a town entitled to the slightest notice, except Frankfort. The fourth lock-dam is about a mile below it. The bottom on which the town stands is north-east of the river, elevated above high-water mark, and has an altitude above the Gulf of Mexico of about four hundred and eighty feet. Its area is very limited, and hills upward of three hundred feet high closely environ it to the west, north, and east. Between the northern and eastern hills a small stream, with swaley borders, makes its way, through a valley disproportionately wide, to the river. This valley, I was told, opens into the river below the town, and seems to have been once the bed of a part of the river. To the south, on the opposite side, but a little above, there is a tract of bottom-land as large as that on which the town is built. It is less elevated than the town-plot, and sometimes suffers inundation. This locality has always been subject to intermittent and remittent fevers, in which the people living in South Frankfort, and near the obsolete river-bed to the north-east of the town, have participated most deeply. The penitentiary of the state stands near the upper end of this outlet, and Mr. Joel Scott, who was its keeper for nine years, informed me that intermittents occurred among the convicts every autumn. According to Snead, just quoted, the conversion of the river opposite and above the town into a deep and permanent pool, has diminished the frequency of fevers.

Frankfort is an old-settled town. Its Lat. is 30° 14′ N. The inhabitants are supplied with hard water.

V. UPLAND PORTION OF THE KENTUCKY RIVER BASIN. — Every part of this basin is uneven, ridgy or hilly, rising in the east into mountainous. Swamps are almost unknown; but it has some small natural ponds, and latterly, a much greater number formed artificially, not for irrigation, but for stock-water. This suggests that the tributary streams of the Kentucky River generally are apt to fail, which is the fact. In dry summers and autumns, the beds of many even become dusty, while all are reduced to the condition of pools, united by thready currents. As most of them have rocky beds and limited alluvial bottoms, this drying-up is not accompanied by the production, to any great extent, of autumnal fever; and no region over which we have traveled, east of the Mississippi, is, on the whole, more exempt. It is a fact, however, that even those ridges which are separated by the most transient brooks, and where scarcely any surface-water can be seen after the summer solstice, *remittent* fever is not uncommon; while in the neighborhood of the larger streams there are superadded mild intermittents; the latter, however, are the more frequent of the two. This basin comprises the oldest settlements anywhere on the tributaries of the Ohio, except those of Western Pennsylvania, as they date back to the year 1774; and consequently its forests are extensively destroyed or thinned out; and most of its surface was long since transformed from a wild to a cultivated state. Through all these conditions, consequent on its settlement, it seems to have been but lightly affected with autumnal fever, except on the banks of the larger streams. The special topography of a few localities will further illustrate the whole.

VI. Danville.—This town, one of the oldest of the state, is situate only ten miles south-east from Harrodsburg, and two miles from Dick's River, a tributary of the Kentucky. As the seat of a college and of the State Deaf and Dumb Asylum, it has claims to a passing notice of its topography and autumnal health. The site is a flatted ridge, passing into a surface still leveler, especially to the south-east. There are some small ponds, both natural and artificial, in its neighborhood, but no marshes. Its rivulets and streams, like those in other parts of the basin, become sluggish or dry up in summer and early autumn. Like the neighboring town of Harrodsburg, already described, it is very slightly affected by autumnal remittent fever. Danville, just described, stands not far from the most southern portion of the great bend of the Kentucky River, mentioned in the general description. We must now cross the river to the north, and say something of the tract of country found within the bend.

VII. Counties in or near the Great Bend of the Kentucky River.—The counties of this locality, are Clark, Jessamine, Fayette, Scott, and Woodford, which have ever been, and still are, regarded as the garden-spot of Kentucky. They are among the oldest-settled portions of the state, and their surface is nearly all inclosed. The natural herbage, cane-brakes, and shrubbery are destroyed; but many open forests have been preserved, and a turf of blue-grass flourishes beneath their shade. The sub-stratum of the whole is Silurian limestone, on which rests a deep stratum of loam and mold. Marshes are almost unknown, but artificial ponds are numerous. The streams, in summer, become stagnant, and many dry up. In Fayette, the central and most important county, much of the surface originally presented deep and almost level deposits of black soil, abounding in moisture, and overshadowed by dense cane-brakes. The organic matters contained in these beds, have long since, by cultivation, been thoroughly exposed to the action of the air, rains, and sun. This tract, so noted for its fertility, is drained by the Elkhorn, a tributary of Kentucky River; and has been made the subject of a paper in the Transactions of the American Philosophical Society, by the late distinguished Abbé Correa, Portuguese Minister to the United States, who was of opinion, that there had once been upon it a great deposit of vegetable matter, the decay of which had generated the deep stratum of mold. The chief prevalence of intermittent fever within the district we are now exploring, is along the trunk and branches of the Elkhorn, where it is not connected with alluvial ground, but with the reduced volume and slackened current of the water.

VIII. LEXINGTON.—The city of Lexington stands in Lat. 38° 2′ N., and Lon. 84° 26′ W. Its elevation above the sea is eight hundred feet. One of the upper branches of Elkhorn Creek passes through it, the gentle slopes towards which, cause a perfect drainage of the site; but the stream as it flows off to the west, sinks into pools, in summer and autumn, and thus creates a limited source of insalubrity, to the windward of the city. Moreover, in different directions round the city, the surface, although decidedly undulating, does not favor a rapid escape of the rain-water, and many of the brooks have a sluggish current with spongy borders. Nevertheless, intermittent fevers are almost unknown, and remittents by no means common. Lexington is gradually becoming a summer-residence for southern families, for which its topographical condition gives it a decided fitness. A southern physician told me that, while a student, he spent eighteen months in that city, during which, without the use of medicine, an enlargement of the spleen—the result of intermittent fever—under which he had suffered for a considerable time, was entirely removed.

Lexington was once the metropolis, not only of Kentucky, but of the West. The first Lunatic Asylum and the first University in the Valley of the Mississippi, were established there. The medical department of the latter was organized in the autumn of 1817, and then began those medical teachings in the Interior Valley, which are now conducted by so many persons at such distant points. Its *alumni* have become the founders of schools, the editors of journals, and, largely, contributors to the work in which this testimony to a pioneer institution is recorded.

IX. South of the Cumberland River, the prevailing agriculture is that of cotton; north of that river, to the Kentucky River, of tobacco; north of the Kentucky, of hemp. Wheat runs through the whole, as maize runs through every region from the Gulf of Mexico up to that we are now studying. South-east of Lexington, at the distance of forty or fifty miles, begin the slopes of the Alleghany Mountains, and the Silurian limestone disappears beneath the shales and sandstones of the Appalachian coal formation. Of the prevalence of autumnal fever in that portion of the Kentucky River Basin, I am not informed. North of Lexington for about twenty miles, the topography remains nearly unchanged; then the surface becomes deeply cut, and of course rugged. The Silurian limestone is covered with clay bearing a thin layer of soil. Surface-water is scarce. The principal stream, Eagle Creek, a tributary of the Kentucky, sinks low and becomes pondy. On the ridges, except near the stream, intermittents are almost unknown, but remittents occur more or less every year. Over this kind of surface we reach the Ohio, between the mouth of the Kentucky River, and that of Licking eighty-five miles higher up, and nearly half a degree farther north. Between the two there is no locality that merits special notice.

SECTION IX.

BASIN OF LICKING RIVER: NORTH-EAST KENTUCKY.

I. Licking River may be compared with Green and the Kentucky, to which it is parallel in course, and approaches in size and the area of its basin. Its sources are among the outliers of the Cumberland Mountain, immediately north of those of the Kentucky River; its junction with the Ohio is opposite Cincinnati. Its southern tributaries interlock with those of the Kentucky River, its northern with the brooks and rivulets which flow into the Ohio. Commencing in the Appalachian coal formation, it pours its waters into the Ohio, over the lower Silurian, or blue shell limestone of Cincinnati. I may add, that it flows a greater distance through that formation than any other affluent of the Ohio River. Almost everywhere it winds tortuously through a ravine, embracing narrow alluvial grounds, or none at all, until it approaches the Ohio, where, like those of the other tributaries, they widen. Its bed and banks are generally composed of rock. Its current is unequal, and in summer and autumn it presents alternate pools and ripples. Thus, in some places where it winds and labors among the hills, the surface of stagnant water becomes quite as great as if the country were flat and pondy. In the spring of the year, its freshets often overflow its banks. Nearly all its tributaries conform so exactly to its model, that a separate description is unnecessary.

The surface of this basin, as far up as the eastern out-crop of the Silurian limestone (which is nearly as far as we find much population), is rolling and rather arid, but has scattered mill-ponds, and is beginning to abound in artificial ponds, on which the agricultural population rely for stock-water, as permanent springs are scarce, and wells not only difficult to be dug through the hard Silurian strata, but often unproductive of much water. More than half of this basin has but a thin covering of mold, resting on a firm stratum of yellow clay, containing very little sand; but the remainder is as fertile as any portion of the Ohio Basin. The predominant trees of the former variety of soil, are oak; the latter is, or rather was, clothed in trees and shrubs which flourish on the richest soils of the middle latitudes, overshadowing the most northern cane-brakes found in the Great Interior Valley. Among the forest trees I may designate two as abounding, and which are almost as characteristic of a locality but little infested with autumnal fever, as the cypress and liquidambar are indicative of the opposite condition,—they are the blue ash (*Fraxinus quadrangulata*) and prickly-shelled buckeye (*Æsculus Ohioensis*).

Some portions of this basin, as the counties of Mason, Nicholas, and Bourbon, which constitute its center from north to south, are among the oldest-settled and most populous parts of the state of Kentucky, but the infertile soils are still but thinly peopled.

Of autumnal fever it may be stated, that the intermittent variety is limited to the neighborhood of the water-courses, where it appears annually in a simple and mitigated form. The remittent variety occurs in the same localities, and also on the dryest ridges, between which there are no stagnant waters. Its character is commonly simple or inflammatory, tending to a continued or typhous type. But I may express this fact in a more specific manner. It is instructive to travel along the valley of the Licking, and its tributaries — Stoner, Hinkson, Johnson's Fork, and the North Fork — and find intermittents every autumn, while the intervening tracts of low-ridgy and arid surface between them, remain exempt, but are liable to remittents. In the once flourishing, but now decayed town of Washington, Doctor Bayless, a native of the place, informs me intermittents are absolutely unknown; but remittents occur more or less every autumn. There is so little surface-water, that the inhabitants have sometimes been compelled to haul water from the Ohio, at Maysville, a distance of four miles.

To the catalogue of anomalies presented by our autumnal fever, I may add two, which, it is true, are multiples of known irregularities, rather than novelties.

1. In the year 1795, a family settled in the woods, one mile out of the village of Mayslick, in Mason county, on dry blue-ash ridges, remote from all stagnant water, and remained entirely exempt from autumnal fever until the fall of 1800, when three children were seized, about the same time, with simple tertian intermittents, which proved obstinate, but not violent. The neighbors around remained unaffected, and the disease did not again occur in the family.

2. The village just named was situate under nearly the same topographical circumstances. It was settled in the year 1788, and its inhabitants remained free from autumnal fever, with the exception of sporadic cases, until the autumn of 1806, when an endemic remittent, manifesting a typhous tendency, arose and prevailed for two months, affecting part of the inhabitants of almost every house in the village, with many in its vicinity.* By a careful examination, I ascertained that the topographical circumstances of the village were the same that year that they had been before, except what resulted from a great drought; the very condition which is said to preserve dry localities from autumnal fever, and promote it in the wet.

II. The Blue Licks.—This singular locality deserves a passing notice.

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* Drake, in Barton's Med. and Phys. Jour., Vol. III, p. 85.

Its center, twenty-four miles south from the Ohio at Maysville, is traversed by Licking River, on the banks of which are the Salines, vulgarly called 'Licks,' from the practice which the herbivorous animals of the forest had of licking the saline earth around such springs. The brine of these fountains is so dilute, that salt is no longer manufactured from it.*

The characteristic of this locality is the absence of the stratum of soil and loam from the Silurian limestone, and a great deficiency of forest trees. The surface presents little else than dark moss-covered rocks. In latter years, however, groves of red cedar are beginning to overspread and increase its wildness. At what time and from what cause this tract lost its earthy covering, and became denuded of trees, or whether they had always been kept from growing there, cannot be told. Many years ago, the late Colonel James Morrison, of Lexington, informed me, that he first visited this spot in 1775, at which time the buffalo or bison (*Bos Americanus*) frequented it in such numbers, that they had formed roads to it from various parts of the country. They were accustomed to remain in the vicinity of the springs (drinking the salt water) for many days, on each visit, and to their depredations and trampings, with the action of the rains, he ascribed the formation of this desert in the midst of a fertile country. The discovery of the bones of the mastodon, and other gigantic extinct herbivorous animals, near the springs, shows that they, also, had frequented this locality. The Blue Licks are now resorted to as a watering-place. Muriate of soda, with abundance of sulphureted hydrogen gas, is the predominant ingredient of the water; which is shipped in barrels, and extensively consumed over the West and South.

In former times, when salt was manufactured here by furnace-heat, autumnal fever seems to have prevailed but little. Latterly, however, the sluggish river which winds round the springs, generates intermittents, which, nevertheless do not become prevalent until the latter part of summer, when watering-places are not much frequented. As some etiologists have fixed upon sulphuretted hydrogen as the efficient cause of autumnal fever, it may be asked, whether the intermittents of this locality should not be referred to that gas. The answer is, that the river is also present, and that the disease occurs with still greater violence in other places along that stream, where no sulphureted hydrogen is disengaged.

In concluding this account of the Licking Basin, I may remark that, in ascending towards the sources of the river, to the margin of the coal basin, the country becomes so barren and broken, that its population is sparse, and that but little is known to me of its autumnal health. That little indicates it to be good.

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* The medical historian may perhaps be pardoned, for turning aside from his legitimate path, to say that, it was while attempting to make a little salt for his venison, at this place, in the year 1778, that the renowned Ohio Valley pioneer, Daniel Boone, was captured by the Indians; and that within this locality, in 1782, they fought a bloody and victorious battle with the first settlers of Kentucky.

III. Banks of the Ohio north of the Licking Basin.— For nearly a hundred miles the Licking basin extends almost to the hills, from which you may look down upon the Ohio River. Let us descend upon the banks of that river. On either side of the mouth of Licking, are the towns of Newport and Covington (*Pl. XIII*), which, however, belong to the Cincinnati locality, and can be best noticed in connection with that city. In ascending the river from this point, its left or southern bank presents the usual succession of bottoms, alternating with those of the opposite side, and mostly elevated above ordinary river freshets.

Augusta, an old village, and the seat of a college, stands on one of these high bottoms, with hills in its rear; and is but little infested with autumnal fever. The next locality above which merits a description is that of—

Maysville.—This ancient landing-place of most of the immigrants to the state of Kentucky, has a historical importance that entitles it to attention; a claim which is strengthened by its being the most considerable town of North-east Kentucky. Its site is a narrow but high bottom, the surface of which is never reached by ordinary floods of the river; a small stream enters the Ohio at the upper end of the town, beyond which is a wider and lower bottom; but both lie to the leeward of the town. The bold and closely adjacent hills are composed of old Silurian limestone. On the opposite side of the river, there is a bottom of considerable width, which is sometimes overflowed. The autumnal fevers of Maysville and its vicinity are of a mild character.

The Ohio River above this town continues to present nearly the same banks and hills as below, until we ascend about twenty-five or thirty miles, when the latter become more lofty, and show by their outlines and aspect a change of geological character. We here leave the Silurian limestone (which dipping south-eastwardly sinks beneath the surface), and enter the Devonian sandstone and slate which underlie the Appalachian coal formation; and henceforth, as long as our exploration of the south side of the Ohio Basin continues, we shall travel over carboniferous and sub-carboniferous formations, with aspects of surface so different from most of those on which we have been looking, as to constitute it a new region. Before entering it, however, we must recur to some general views of the one we are about to quit.

SECTION X.

GENERAL REMARKS AND CONCLUSIONS.

Having completed a survey of the fertile and populous part of the basin of the Ohio south of that river, it will be proper, before leaving it for another part of the basin presenting very different characters, to recapitulate some of its topographical and geological features.

I. Its southern and western boundaries are the sources of the streams which enter the Tennessee River through its left bank; the Ohio River constitutes its northern and a part of its western boundary; while to the east it is bounded by the great out-crop of shale and sandstone which has a line of bearing from the Ohio River, above Maysville, to the Tennessee River, near Huntsville, the course being nearly south south-west. Immediately east of this high and abrupt margin, we come to the western side of the Appalachian coal formation.

II. Much of the largest limestone region of the Interior Valley of North America lies west of this out-crop, in Kentucky, Tennessee, and Alabama.

III. The creeks and rivers more generally flow in narrow ravines than those of any other portion of the Great Valley, and have more limited alluvial bottoms.

IV. While, as intimated in the first section of this chapter, the surface of that portion of the Ohio Basin which lies north of the river, is extensively buried up with *drift* or transported materials (much of it brought from a great distance in the north), the region we have been exploring has none; the trough of the Ohio River being its southern boundary.

V. The deposits of organic matter in all parts of the region we have explored, are comparatively limited in depth and area.

VI. Swamps, marshes, and sloughs are almost unknown; but ponds and pools, both natural and artificial, are common in every part.

VII. Copious and permanent springs are scarce; and the greater part of the countless number of brooks which irrigate the country in spring, dry up between the summer solstice and the autumnal equinox, or subside into stagnation.

VIII. When we compare this great region of transition and secondary rocks, with the cretaceous and tertiary regions lying between it and the Gulf of Mexico, we find instructive evidence of the influence which the geological constitution of a country exerts on its medical topography and hydrography; each of the two regions having a characteristic surface of deep interest to the physician, which is clearly referable to its geology.

IX. In the region we have explored, it was found that, as we advanced from south to north, there was a diminution in the prevalence of intermittent fever, which, at the same time, became more simple; there was also, but in a less degree, a diminished prevalence of remittent fever, and a gradually increasing tendency to assume a continued type. Although change of climate is a manifest cause of this modification, it is not, I presume, the only one: for we must, also, admit a telluric influence.

SECTION XI.

THE OHIO RIVER, FROM MAYSVILLE TO BIG SANDY RIVER.

As intimated in the last two sections, when we ascend the Ohio to the distance of twenty-five or thirty miles above Maysville, the hills which from near Louisville are composed entirely of Silurian limestone, gray and blue, begin to show caps or summits of Devonian slate and sandstone, and at length are composed of those formations down to the water's edge. As we continue to advance, a conglomerate or pudding-stone takes their place on the high hill-tops, and soon replaces them to the depths of the valleys. These changes result from an eastern or south-eastern dip of all these formations, beginning in the region between Cincinnati and Maysville, while west of that line the dip is in the opposite direction. Beyond the out-crop of conglomerate (which shoots up into lofty pinnacles) come the great deposits of iron ore, the salt wells, and the coal measures of the Appalachian formation, which we first met in North Alabama and East Tennessee. From this signal change of geological structure there results a topographical change, which is obvious to the eye of the ascending voyager; but the country on each side displays it, even more than the trough or immediate valley of the river. This continues substantially the same as it was from Louisville to Maysville; but both the river and its valley are perceptibly diminished in width, and, on the whole, the bottom-lands are less subject to inundation, except at the junction of some of the principal tributaries.

South of this section of the Ohio, the country is rugged; has an elevation of three or four hundred feet over the limestone country farther west; and is little fitted for cultivation, and but thinly peopled; characteristics which it preserves through to the Tennessee. I know but little of its autumnal diseases, which are undoubtedly of a mild character, compared with those along the lower portions of the rivers which originate in this sub-alpine belt.

SECTION XII.

BASINS OF THE BIG SANDY AND GUYANDOTTE RIVERS.

The mouths of these rivers are but ten miles apart, and in their general course they run nearly parallel, with interlocking tributaries. The former, which is the larger of the two, makes a part of the dividing line between Kentucky and Virginia. Its junction with the Ohio is about ninety miles above Maysville. The natural historian of the coal region (which includes these rivers) is the able and indefatigable Doctor Hildreth, of Marietta, Ohio,* who from personal observation gives us the following description:

"The space occupied by the tributary branches of these two streams, covers an area of about one hundred and twenty miles of latitude, and one hundred miles of longitude. Their head-waters rise a little north of the thirty-seventh degree, and interlock with those of the Clinch and Holston Rivers, and some of the western tributaries of the New River or Kenawha. Their extreme branches descend from the most elevated peaks of the Cumberland group of mountains, and from the flat mountains or table-lands found between the heads of the Holston and the Guyandotte. In their descent from this elevated region, they pass through some of the most wild, broken, and picturesque country to be found in the west. Immense deposits of sandstone rocks, piled up in enormous masses to the hight of fifteen hundred or two

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* Silliman's Journal, Vol. XXIX, No. 1.

thousand feet, compose all the center part of this region. The streams are confined to narrow ravines and valleys, so deep as hardly to admit the rays of the sun at noon-day. Except near the borders of the larger streams, this whole district is a perfect wilderness. The scanty population which is widely scattered over its surface, obtain their support by hunting and digging the roots of the ginseng, an article as highly prized by the Chinese, as their more delicate teas are by us. This beautiful plant grows with great luxuriance and in the most wonderful abundance, along the rich virgin soil of the hill and mountain sides, composed of the disintegrated sandstone and the decayed leaves of the forest, which have been accumulating, undisturbed, for ages. For thirty years these hills and forests have furnished a constant supply of thousands of tons of this plant to the traders stationed at remote points along the larger streams. * * * The hills and mountains, although steep and broken, are covered by an immense growth of forest trees, of all the species common to the climate, which here attain an elevation and a magnitude not seen in any other place; rich mountain sides in a temperate climate always affording a heavier and taller growth than the lowlands. * * * It is but a few years since the bottom-lands on the Sandy were clothed with cane; and as late as the year 1805, boats visited that stream as high up as they could navigate, until checked by the falls, for the purpose of collecting the stems of this gigantic grass to be manufactured into reeds, &c. Since the ingress of domestic animals, the cane has wholly disappeared, except in some inaccessible recesses."

As Doctor Hildreth has said nothing of the autumnal fevers of this alpine region, which extends through Eastern Kentucky and Western Virginia to the upper valley of Tennessee River, I wrote to a gentleman of Ohio, Mr. George A. Warder, who had traveled up and down the valley of the Big Sandy: and although his answer is not full on that point, I will give an extract from it, as further illustrating the medical topography of a region but little known, although nearly surrounded by old settlements:

"I have passed up and down the Big Sandy River several times, and at various seasons of the year. The main river is about one hundred and fifty miles in length, rising in the mountains of South-western Virginia, and flowing a northerly course to the Ohio. The alluvial lands on the head streams are very narrow, and would not be considered worthy of cultivation in Ohio, but as the mountains are sterile, these small bottoms are occupied. As you descend, the valley widens to about a mile; from within sixty miles of its mouth the farms increase in size, and have a rich, warm, sandy soil. From the junction of the Louisa Fork with Tug Fork, twenty-five miles above the mouth, there is so little fall, that every considerable rise in the Ohio River affects this stream; and as there are a number of creeks emptying into it, every time a rise in the Ohio occurs, the back-water fills the outlets of these streams. The Sandy River is subject to very great and sudden rises; and I have been told that it has risen in one night sixty feet above its usual level, of course overflowing the bottom-lands and doing much damage. This can easily be accounted for, as the river is short, rises in the mountains, and has a great deal of fall from its sources to the main trunk, which has very little. I do not remember ever having seen ponds of stagnant water anywhere along the valley. The upper part of this valley is very healthy; and I never saw or heard of ague and fever there;—but as we descend the stream, we might suppose its borders liable to that disease, yet I did not witness it. The water is beautifully clear, and is generally used by the inhabitants for drinking and household purposes, as there are but few springs. I believe there is no limestone from the source to the mouth of the stream, its course being entirely through sandstone."

SECTION XIII.

BASIN OF THE KENAWHA RIVER.

I. General Description.—This alpine river, one of the greatest tributaries of the Ohio, has its origin, by many large streams, among the summits of the Appalachian Mountains of Virginia and North Carolina, at an elevation of from two to three thousand feet above the level of the sea. The principal and longest stream, called New River, begins in the granite escarpment of the Blue Mountains, within the latter state, and takes a course nearly north. The Greenbrier, which belongs to the former state, first joins it, and then succeeds the Gauley, when the common trunk assumes the name of Kenawha. Between the mouths of Greenbrier and Gauley Rivers, the distance is seventy miles, in passing through which New River descends more than seven hundred feet. Soon after their being joined by the Gauley, the united waters are precipitated twenty-two feet, from a ledge of sandstone. These are the 'Great Falls,' whence the river flows with a gentler current to the Ohio, at Point Pleasant, seventy miles below. From its utmost source in North Carolina, this river, pursuing a north-west course, has boldly cut its way through several mountain chains, and thus develops some of the wildest and sublimest scenery within our Great Valley. On this, however, we must not dwell, but proceed to direct our attention to such localities as are of interest to the medical topographer.

II. Valley of the Greenbrier.—This, in the opinion of Doctor Hildreth, was once the basin of a lake. To the east and west it is bounded by the mountain ranges denominated Alleghany and Greenbrier, which are thirty-five or forty miles apart in the south, where New River, cutting through both ranges, traverses the valley nearly at right angles to them, and on its way from one to the other, receives Greenbrier River. To the north-east, at the distance of one hundred miles, these mountains, by gradual approximation, coalesce, and there Greenbrier River has its beginnings. These sources are two thousand feet above the level of the sea, and the junction of the stream with New River is at the altitude of thirteen hundred and twenty-five feet. Thus, the average elevation of the basin may be taken at sixteen hundred feet, while the mountains which bound it are as much more. Over its whole surface there is a thick calcareous deposit, resting on sandstone, with sinking springs, and caves containing salt-petre earth. The soil of the valley is calcareous, and abounds in decomposed vegetable matter. Its surface is hilly, with some spots called 'levels.' The celebrated White, Blue, Red, and Salt Sulphur Springs of Virginia lie in this valley.

III. Valley of the Gauley. — "This stream is about one hundred miles in length, and, at its mouth, more than one hundred yards in breadth. It takes its rise in the spurs and sides of the Laurel, Greenbrier, and Gauley ranges of mountains. The country through which it passes is mountainous, and broken into lofty precipitous hills of sandstone rock. 'The cliffs of Gauley' are second only in hight and grandeur to those of New River; extending for many miles on each side of the stream, at an elevation of five or six hundred feet. The river itself is precipitated over falls and rapids for a considerable part of the course; and its bed is so filled with huge blocks of sandstone rock, as to prevent any navigation on its waters."

IV. Glades. — "Toward the heads of this river, the mountains spread out into table-lands, known by the name of 'glades.' They lie in long narrow patches, at an elevation of seven or eight hundred feet above the water-courses, with an elevated ridge or border along their sides, through which, at intervals, are found gaps for the water to pass off, down immense precipices, to the streams below. They are destitute of heavy timber. The more elevated and dryer portions produce fine crops of barley, oats, and potatoes, while the more wet afford good meadows, and the swampy places produce cranberries in abundance. The soil is black, based on yellow clay: indicating that these were, at some remote period, the beds of lakes or ponds."

V. Autumnal Fevers. — As the valleys of New River and the Greenbrier, with the table-lands or glades of the Gauley, have an elevation of from sixteen hundred to two thousand feet above the ocean, with moist soils, abounding in organic matter, and are comprehended between the parallels of thirty-seven and thirty-nine degrees of north latitude, they afford appropriate localities for ascertaining the influence of elevation on autumnal fever in those latitudes. Unable to visit them, I have sought, by correspondence, to obtain the desired information; but of twelve letters written to physicians in that region, two only have been answered. Doctor W. L. Bondurant, of Pocahontas county, high up Greenbrier River, in north latitude thirty-eight degrees fifteen minutes, writes as follows: "The surface of our soil is fertile, especially that of the Greenbrier bottoms, which are low and annually overflowed. On or near these bottoms there are scattering cases of intermittent fever every year; but remittent is much commoner, and often assumes a congestive type, terminating fatally in four or five days." From Doctor David M. French, of Giles county, far up New River, in about north latitude thirty-seven degrees fifteen minutes, I have received the following: "The valley of New River is at an elevation of from two to three thousand feet above tide-water. The general aspect of the country is mountainous. The soil of the parts which are sufficiently level for cultivation, is rich, productive, and peculiarly adapted to the growth of grass. Our climate is dry, but subject to great variations. Remittent fever is almost unknown among us; and intermittents are rare occurrences. They happen only in wet seasons, and are always mild." By Professor Rogers, of the University of Virginia, whose geological survey of that state carried him in the region now under consideration, I have been favored with the following facts: "Along New River, from the mouth of Gauley up to the Blue Ridge, I have noticed cases of autumnal remittent and intermittent fever. These I have observed more commonly in the open districts, as in Monroe and Giles counties, than where the river traverses the mountains; but in no part of this region do they prevail as generally as in the Kenawha valley below. The extent of river-terrace or bottom-land is not so considerable in this upper valley of the river; but where such deposits occur they are covered with a productive soil, well charged with organic matter. The same remarks, as to health and soil, apply perhaps more strongly to the Clinch, and other streams flowing into the Tennessee River."

It would appear, from these observations, that an elevation of eighteen hundred or two thousand feet, in the latitude of thirty-seven or thirty-eight degrees north, is not sufficient entirely to prevent autumnal fever in localities which contain fertile soil abounding in organic matter.

VI. LOWER VALLEY OF THE KENAWHA.—From the Great Falls to its mouth, the Kenawha gradually widens, and its valley expands from half a mile to nearly a mile. The hills which bound it have, in the upper part, rather a sharp outline, with an elevation of seven or eight hundred feet; but they gradually sink to two hundred and fifty, and at the same time become more gentle. Two lateral valleys, through which Coal and Elk Rivers flow into the Kenawha, have the same topographical character with the principal valley. Its bottoms, composed of the *debris* of the coal formation, are, on the main, above high-water mark and well cultivated. Near the Ohio, however, they are more depressed, and as Doctor Couch and Doctor Shaw, of Point Pleasant, at the mouth of the river, informed me, are subject to inundations which leave, on receding, ponds and sloughs, abounding in decomposable matter. In descending the river early in July, I observed, that when reduced in volume, it becomes a line of pools and rapids.

The people who live near the mouth of the Kenawha suffer more from autumnal fever than those who inhabit the neighboring bottoms of the Ohio. Their elevation above the sea is about six hundred feet, or one-third as much as the altitude of the mountain localities which have been described. Their latitude is a little less than thirty-nine degrees north. Above the estuary of the river, up to the Great Falls, the fever is scarcely ever epidemic, and malignant cases are almost unknown.

VII. THE SALINES.—These extend ten or twelve miles up the valley, beginning at Charleston, about fifty miles from the Ohio. The width of the valley may be about half a mile; its course nearly north and south. The ranges of hills which bound it on either side rise from five to seven hundred feet above the bed of the river; and are composed of the sandstones, shales, and coal-beds of the carboniferous formation. The river-terraces are in general so high as not to be submerged, except in extraordinary floods. The number of fountains is great, and they have been created by deep Artesian borings, from some of which there is a copious escape of hydrogen gas. As the brine is not evaporated by solar, but culinary heat, a vast number of furnaces, supported by bituminous coal, are night and day in blast. Some of them, however, are maintained by the combustion of the hydrogen gas which rises with the water. The peculiarities of this locality are, *first*, the escape of that gas into the atmosphere; *second*, the development of a great deal of caloric; *third*, the copious diffusion of the gases generated by the combustion of coal; *fourth*, the elevation of immense volumes of steam, holding salt in solution. Now, what is the effect of all this on the prevalence of autumnal fever among the agents and operatives? The answer given by the medical gentlemen of the valley is, that those persons are not quite as liable to the disease as the people who reside away from the furnaces. The inhabitants of Charleston appear to suffer but little from it.

VIII. The Kenawha Basin, taken as a whole, is too rugged and unproductive to admit of a dense population. The inhabitants will be chiefly in its narrow valleys and mountain glades. Much of it must forever remain a wilderness.

The Little Kenawha, which joins the Ohio sixty or seventy miles above the Great Kenawha, so closely resembles it in geology and topography, that a separate description is not necessary. Above the mouth of this river, where we find the town of Parkersburg, the left bank of the Ohio presents nothing of interest to the etiologist until we reach the old town of Wheeling; which, however, I shall describe in connection with the banks of the river above, after having first completed the survey of another, and the last hydrographical basin south of the Ohio River.

SECTION XIV.

BASIN OF THE MONONGAHELA RIVER.

I. Outline Description.—The Monongahela is the southern of two nearly coequal rivers, which unite at Pittsburgh to form the Ohio. Its basin lies between that of the Kenawha and that of the Alleghany, north of the former and south of the latter. An account of it will finish the description of the southern half of the Ohio Basin.

The Monongahela River is composed of four subordinate streams: *First*, The West Branch, which originates in the south-west, where it interlocks with the sources of the Little Kenawha, and of Elk River, a tributary of the Great Kenawha. Its course is nearly north-east. *Second*, The East Fork, or Tygart's Valley River, which interlocks, in sources, with the Gauley and Greenbrier, and running north unites with the West Branch. *Third*, Cheat River, lying further east, originating on the slopes of Cheat Mountain, where it is connected with the head of Greenbrier River, whence it runs northerly to join the common trunk of the last two branches. *Fourth*, The Youghiogheny, north-east of the Cheat, which flows to the north-west, and joins the common trunk below that stream.

Every part of the Monongahela lies within the coal measures of the Appalachian carboniferous formation, and it has the distinction of being the largest river of the Great Interior Valley that begins and ends within those measures. Coal is found in every part of the basin, and the rocks are sandstone, shale, and that limestone which is found within the coal series.

The surface of this basin is less elevated and rugged than that of the Kenawha, yet its south-eastern portion is mountainous, with some cultivable valleys and table-lands or glades. The remainder, which has a population of considerable density, is characterized by Doctor Hildreth in the following terms: *

"The streams are turbid, and tortuous in their course; and as they descend to the valley, they become slow in their progress. The springs are few and small, and readily affected by the droughts of summer. The hills are irregular in their hight, and in their arrangement, but they are generally very fertile, covered with a rich argillaceous soil to their very summits, and produce a luxuriant vegetation, such as is usually found only on rich alluvions; they are invariably clothed with forest trees of the most lofty hight."

Neither the assemblage of small rivers which constitute the Monongahela, nor the main trunk itself, can be regarded as alluvial, for their bottoms are in general narrow. Some of the tributaries, however, flow for a distance in the broad synclinal axes or valleys which lie between mountain ranges, of which the following is an example:

II. TYGART'S VALLEY.—"One of the most interesting spots in the topography of this region," says Doctor Hildreth,† "is Tygart's Valley. It lies near the heads of the 'Valley River,' twenty miles south-east from Clarksburg; Beverly, the county seat of Randolph, lies in this valley. It is about seventy miles long, including that portion on Leading Creek, and in breadth it varies from one to three. Its boundaries are formed by ranges of the Cheat and Laurel Mountains, rising to a great hight, and affording many proofs that this valley has once been occupied by a lake. The accumulated waters, rising above the elevation of the Laurel range, have here forced a passage, and the Valley River, and Leading Creek, have formed for themselves channels in the bed of this ancient lake. This passage is about three miles in length, and from three to four hundred yards in breadth, cut down to the base of the mountains. The cliffs of rock on each side are of a stupendous hight, not less than one thousand feet, affording a most grand and picturesque view, and may not inappropriately be called 'the gates of the mountain.' The fissure in the rocks and strata on each side correspond; affording sufficient evidence of their former junction. The rock itself is of the coarsest conglomerate sandstone. Additional evidence of this valley having formerly been the bed of a lake, is also found in the fossils brought up in excavating the earth for wells. * * * The base of the valley

* Silliman's Journal, *loco citato*. † Ibid.

rises very gradually as it advances toward its head in the Cheat Mountains. The river meanders through its whole length with a calm and placid surface. Environed by ridges of lofty mountains, and shut out from the strife and tumult of the surrounding world, this valley affords, at certain seasons of the year, all the natural and picturesque beauties of the fabled valley of Johnson. Here may be found nearly all the rare and curious shrubs and flowering trees indigenous to the western country. * * * Numerous waterfalls and rapids, below the 'gates of the mountain,' give to this sequestered spot, by their noisy contrast, a still greater air of tranquillity. In the distance of twenty-five miles, the river has a descent of several hundred feet, as it passes down the broad plateaus of the mountains into the valleys below. Much of this descent is made up of rapids and ripples, but in other places it forms perpendicular cascades, and pitches over the sandstone rocks, which generally form its bed."

III. The Glades of Cheat and Laurel Mountains.—We have already noticed the glades around the Gauley Basin. Those which are found in the region we are now exploring, belong to the Cheat and Laurel Mountains, and are described by Doctor Hildreth as follows: *

"The whole face of the country becomes elevated, and between the ranges of mountains we meet with long but narrow strips of level land, here called 'glades.' They, in some respects, resemble the prairies of the west, being clothed with a scanty growth of forest trees and shrubs, but are composed of a rich vegetable soil, well suited to the growth of grain, potatoes, and grass, but are too much elevated and subject to late frosts, for the successful cultivation of Indian corn. They were, without doubt, once the beds of lakes, and have uniformly a stream of water passing through their most depending portions. The table-lands of Mexico are here represented in miniature. The glades were once portions of the original bed of the ocean, before the mountain ranges were lifted up, or 'brought forth,'—but at that period were elevated with the ranges to their present hight. Being surrounded by ridges, they, for a long time, remained covered with water, until, by accumulations from the adjacent highlands, the water forced a passage through some less elevated spot, and draining off by degrees the accumulated flood, its bed was eventually laid bare, which bed now forms a modern glade."

IV. Buchanan.—The town bearing this name is situate about the thirty-ninth degree of north latitude, on the left or west bank of a small river of the same name, which discharges its waters into the East Branch of the Monongahela. In its rear, to the west, as I am informed by Mr. White, a student of medicine, there is a considerable tract of bottom, which is liable to overflows, and continues swampy; yet neither intermittent nor remittent fevers occur.

V. Clarksburg.—This is one of the oldest towns of the Monongahela Basin. It is scatteringly built on a small tract of uneven table-land, on the left bank of the West Branch of the Monongahela. The stream sinks very

* Silliman's Journal, *loco citato.*

low in summer, has a rocky bed, and but little side-alluvion. Its elevation above the sea is between eight and nine hundred feet. That of the immediately surrounding hills is about two hundred more. The region in which this town is situated is rugged, with narrow valleys, transient streams, no swamps or ponds, and but few springs; — the sub-strata are shale and sandstone, with seams of coal and very little limestone. On traversing this region from the west, I was told by the people that ague or intermittent fever is unknown, or nearly so; but that every fall they have '*the* fever,' by which they meant remitting bilious fever, tending to a continued type. In Clarksburg, I conversed with the venerable octogenarian, Doctor Williams, who had resided there forty-seven years, and he assured me, that ague and fever had never *prevailed* through that long period, and had scarcely ever occurred sporadically, in the town or its vicinity. Even along the West Branch of the Monongahela, he had never seen a case. Every year, however, he had witnessed more or less of remittent fever. This representation was confirmed by Doctor McCally, who had also practiced in Clarksburg for many years. The agues he had seen were contracted elsewhere; but remittents occurred scatteringly every autumn, on hill and valley alike, and were, now and then, moderately epidemic.

VI. KINGWOOD. — From Clarksburg to Kingwood the general course of the road is to the north-east. It crosses the East or Tygart's Valley Branch of the Monongahela. I found the country dry, the streams transient, and the springs neither numerous nor permanent. Between the west and east branches of the river, the surface is hilly, though not more elevated than around Clarksburg; but beyond the latter branch, the hills become loftier, and the general surface at length rises into low-mountainous. The chief population is in the narrow valleys, where remittent fever occurs to a moderate extent; but intermittent is almost, if not quite, unknown.

Kingwood, like Clarksburg, is seated on a piece of table-land elevated about two hundred feet above Cheat River, which flows a mile and a half from it, on the north-east. Beyond the river is Cheat Mountain. The site of Kingwood is, by estimate, twelve hundred feet above the sea. The surrounding country, in its aspects and vegetation, is wild and alpine; composed of carboniferous shales and sandstones, deeply cut into ravines; and overspread with lofty forests, which embrace kalmias, laurels, rhododendrons, pines, and chestnuts; while its cool and darkly embosomed waters abound in speckled trout (*Salmo fontinalis*), unknown at a lower level, or further west in the valley of the Ohio. It is almost unnecessary to say, that in this region ague and fever does not occur. All with whom I conversed (including Doctor Kidwell and the Hon. Mr. Brown, of Kingwood), testified to this fact. It is, indeed, a popular opinion there, that localities which abound in trout are exempt from ague. Mild remittent fevers, however, occur occasionally every autumn, in that as well as other parts of the Monongahela Basin, but not to the same extent as in its western portions.

VII. SMYTHFIELD, ON THE YOUGHIOGHENY.—This humble village is situate on the right bank of the river, where it is crossed by the National Road, near the eastern base of the Laurel Mountain. The bottoms of the stream, like those along the other branches of the Monongahela, are of limited extent. They are less elevated, by two or three hundred feet, than the plateau on which Kingwood stands. From Doctor Fetter, who had resided in this locality for five years, I learned that he had seen but one case of intermittent fever. It occurred on the river bank, a mile below the village. Remittent fever is, however, a yearly visitor, and appears on the mountain-flats as much as in the valley. Once it assumed an epidemic character, but it has generally been sporadic.

VIII. Lower Basin of the Monongahela. — The lower portions of this valley, and that also of the Youghiogheny River, are no longer mountainous, but constitute a hilly and rolling plain, which stretches off to the Ohio River, from the base of Laurel Hill, the most western of the Appalachian group. Monongahela county, in Virginia, and the counties of Greene and Fayette, with large portions of Washington, Westmoreland, and Alleghany, in the state of Pennsylvania, compose the civil divisions of this limited, but not unimportant, district, which is, properly, the beginning of cultivable country, in coming into the basin of the Ohio from the east. It is traversed by the National Road from the foot of Laurel Hill, through Uniontown, Brownsville, and Wheeling, to the Ohio. That portion which lies near the mountain is more depressed and level than some others. In advancing to Brownsville on the Monongahela, the surface seems to rise and become more rugged. The river, at Brownsville, is seven hundred and thirty-six feet above the sea, and the surrounding hills appear to be, at least, four hundred more; giving them an altitude of nearly twelve hundred feet. Farther west the country rises, almost imperceptibly, to the hight of fifteen or sixteen hundred feet, at Hillsboro, and then sinks gradually to Wheeling, where it does not exceed eleven hundred feet. The principal ravines which have been cut through this district, are those in which the two principal rivers approach and unite, the Youghiogheny yielding up its name, and contributing, by its waters, to prepare the Monongahela for more equal union with the Alleghany, in forming the Ohio River at Pittsburgh. The ravines through which these rivers flow are generally narrow, and comprehend, of course, but little alluvial bottom,— the common character of all the streams of the district. A series of locks and dams has produced slack-water in the Monongahela, from Pittsburgh to Brownsville; between which the difference in level is thirty-two feet.

Much of this district has a calcareous basis and a fertile soil. Its springs are neither numerous nor permanent. It has no swamps, nor any ponds, except those produced by mill-dams, or the subsidence of the streams until they degenerate into pools connected by feeble currents. Chartier Creek, which originates near Washington and flows into the Ohio a little below Pittsburgh, has wider alluvions than the Monongahela, and some of them show small ponds and sloughs; on the whole, however, this district may be placed among the dryest in the basin of the Ohio. Being one of the oldest-settled portions of the basin, its forests have been extensively destroyed.

My information concerning its liability to autumnal fever is the following. At Uniontown, near the base of the mountain, I learned from Doctor H. Campbell and Doctor Fuller, that intermittent fever is nearly unknown in that part of the district, and that patients coming with it from other localities often recover without the use of medicine; but remittent fever occurs sporadically every autumn, and in the year 1819, Doctor Campbell saw it epidemic. In some cases remissions were distinctly marked, but in others they were obscure, and there was a tendency to a continued type. At the Fair Chance ironworks of Mr. Oliphant, seven miles south of Uniontown, near the base of the mountain, intermittents among the operatives were never thought of. At Brownsville, which is built on steep river-hills, that remind one of Vicksburg, Doctor Stanley, Doctor Lafferty, and Doctor Jones, through periods of fourteen, eleven, and four years, had never seen a case of ague and fever, until after the construction of locks and dams for slack-water navigation created a pool, the head of which was near the town. These cases, observed by Doctor Stanley, were, however, few in number, and were accompanied by chills only. Cases of ague from a distance had sometimes proved obstinate; and periodical neuralgias of the brow are not uncommon. Remittent fever is of annual recurrence here, but not, strictly speaking, epidemic. It has frequently shown a tendency to the continued form. In Washington, Doctor Lemoine, in a practice of twenty-five years, had seen but five original or indigenous cases of intermittent fever, two of which were of the town, in a house which had water in the cellar throughout the summer; the other three were near a mill-pond. Doctor Wishart, in the course of a long practice, had seen very few cases, except those contracted abroad. Doctor King had seen a case, in June, in a man who had sojourned in an aguish locality the preceding fall, without then having an attack. All these gentlemen testify to the annual occurrence of remittent fever, but not as an epidemic, except in the neighborhood of some of the streams which abound in ponds. It often assumes a typhous character, and never terminates in an intermittent type. To this testimony I may add that of Doctor Reed, who, although not in practice, had long been an attentive observer in this locality. In the neighborhood of West Alexandria, between Washington and Wheeling, among the sources of Buffalo and Wheeling Creeks, where the surface is tortuously rolling and low-hilly, with good springs and without swamps or ponds, Doctor Davidson, in a practice of eight years, had never seen a case of ague or intermittent; and even remittents appear to be replaced by continued fever; which prevails more in autumn, however, than in other seasons of the year. These observations, extending through this district from the mountains to the Ohio River, a distance of seventy miles, will be sufficient to show the degree to which it is affected by autumnal fever.

IX. WHEELING.—The course in which we have traveled, has brought us back to the Ohio River, at the town of Wheeling. The direction of the river at this place is nearly south-west. The town stands on its left bank, above high-water mark, on two alluvial terraces — a lower and an upper — neither of which is very wide. The lower is composed chiefly of sand and gravel, the upper of sandy loam. These terraces are traversed by Wheeling Creek, which divides the town itself into South and North Wheeling. The creek originates not far to the south-east, where it interlocks with a tributary of the West Branch of the Monongahela. As it approaches the town it winds among the hills, has narrow bottoms with high banks, not liable to inundation; but it receives the back-water of the Ohio when in flood. Immediately opposite the town, there is a large island, which is so elevated as to admit of being highly cultivated. Beyond this island, the hills press hard upon the river, and have an opening or ravine from the west, through which Indian Creek makes its way to the river. Thus, Wheeling, for a river town, is favorably situated, as to the conditions which generate autumnal fever. The elevation of its site is about seven hundred and sixty feet above the sea; that of the surrounding hills, not far from eleven hundred. As to ventilation, it cannot be acted upon with effect, except by winds from the north-east, or south-west and west.

Wheeling, in N. Lat. about 40°, is one of the oldest towns of the Ohio Basin; its population is about ten thousand souls; it has many factories and consumes a vast quantity of sulphuro-bituminous coal, drawn from the adjacent hills.

When Doctor M. H. Houston,* to whom I am indebted for most of these particulars, removed to Wheeling, in 1831, and for two years afterward, intermittent and remittent fevers prevailed to a considerable extent, and were much commoner on the upper than the lower terrace; owing, no doubt, to the latter having the densest population. After an invasion of epidemic cholera, in 1833, these fevers nearly disappeared, and have not since returned, except in the mildest degree. When at Jefferson City, Missouri, (p. 168) Doctor W. A. Davison, who had practiced medicine in Wheeling from 1837 to 1840, confirmed this statement, by saying that he found the fevers of autumn, in his present locality, decidedly more frequent and dangerous than he had found them in Wheeling. A comparison of the topography and relative ages of the two towns will explain this difference. Doctor Houston is unable to designate any topographical changes cotemporary with the cholera of 1833, except a more general paving of the streets, and the substitution of hydrant-water for well-water. The same gentleman has noticed that, in such portions of the hill-country around Wheeling as have a clay surface with a prevalence of oak trees, the fevers of autumn are of a more violent character, than in any other part of this locality.

X. From Wheeling to Pittsburgh.—The distance between these places is ninety miles. In ascending from the former to the latter, the voyage, for half the distance, is directly north, then north-east, and then, for thirty miles, south-east. Thus, a kind of promontory is formed, the surface of which is deeply cut with ravines, giving hills, the summits of which are about eleven hundred feet above the sea, until we approach Pittsburgh, when they rise still higher. As a general fact, there is no marsh and very little

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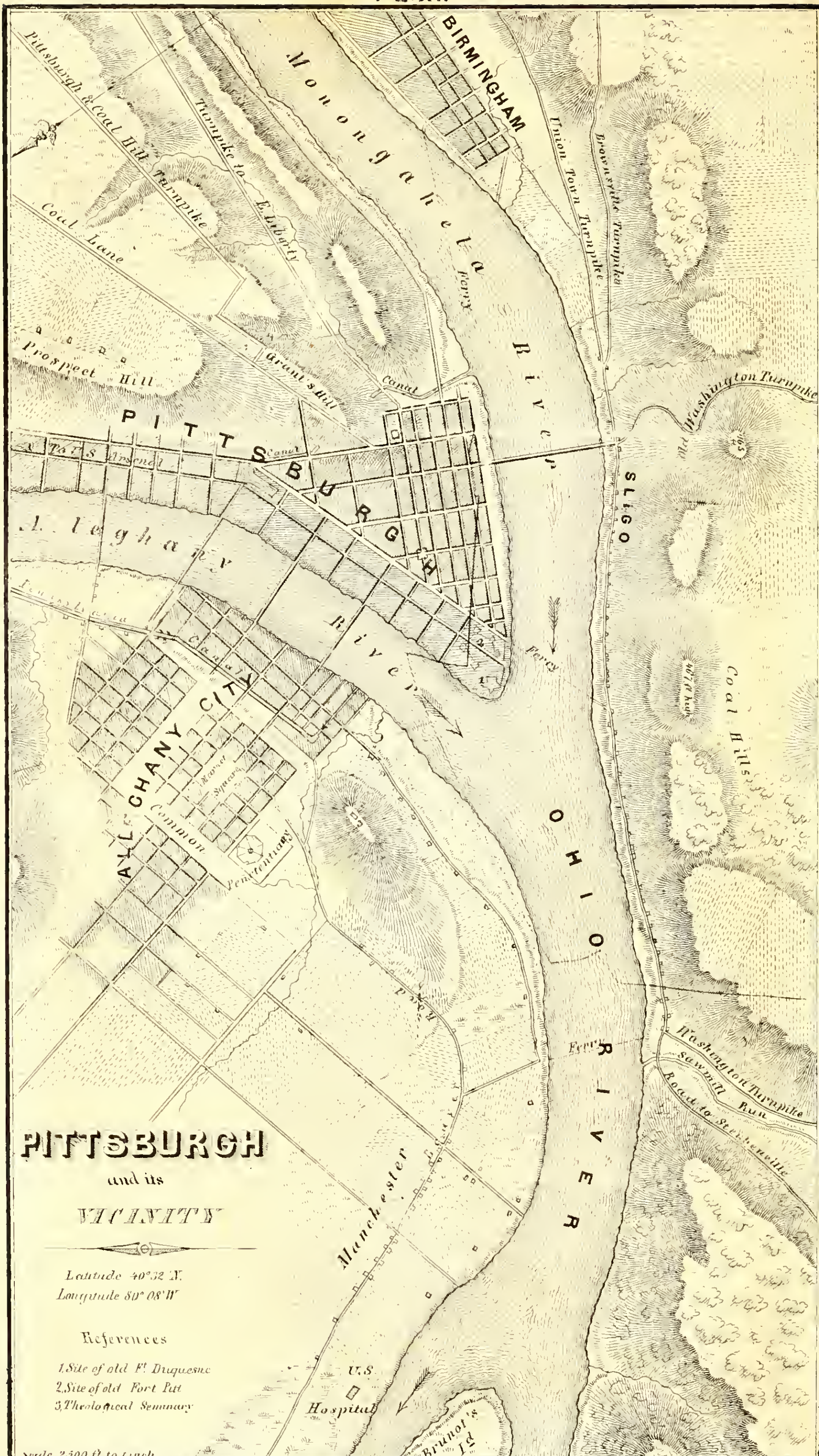
* MSS. *penes me.*



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bottom-land in this peninsula, except along the Ohio and the lower portions of Chartier Creek, where there are sometimes partial inundations. On the upland portions, the exemption from intermittent fever is as great as that of the Monongahela Basin from Uniontown to Washington, of which, topographically, this tract is a continuation. No important town stands on the left bank of the river above Wheeling. The most noted is WELLSBURG. I know of nothing peculiar in its topography. Doctor Grafton, with whom I met in Millersburg, Kentucky, resided nine years in Wellsburg, during which he saw but one case of indigenous ague and fever. Remittent fever prevailed to some extent, and in one autumn almost assumed an epidemic character; but other autumns passed without a single case.

SECTION XV.

PITTSBURGH AND ITS DEPENDENCIES.

I. The western metropolis of Pennsylvania belongs equally to the banks of the Monongahela and the Alleghany Rivers, as it stands on the promontory or point of land above the junction by which they form the Ohio (*Pl. XII*). An account of its topography will finish the description of the southern half of the Ohio Basin and introduce us to the northern.

The latitude of this city is 40° 35′ N.; its longitude 80° 14′ W. The low-water elevation of the adjoining rivers, is seven hundred and four feet above the sea, and one hundred and forty above Lake Erie; the different plains or terraces on which the city and its surrounding towns and villages are built, vary in elevation from a few feet below high-water, to forty or fifty above it. The neighboring hills rise to different hights, up to four hundred and sixty-seven feet above the rivers, making the general summit-level of the surrounding country about eleven hundred feet above the ocean. An inspection of the topographical map (*Pl. XII*) will afford important aid in the study of this locality.

On the south or left-hand side of the Monongahela River, we see a range of steep hills, rising almost from its margin to the hight of four hundred and sixty-five feet above low-water. They continue in this proximity for several miles below the city; but above it recede, so as to give a tract of argillaceous bottom-land, on which the manufacturing town of Birmingham has been erected. Most of it rises above the highest floods of the river. In front of it, is the first of the series of dams and locks which extend up the river to Brownsville.

For a long period of time the town was limited to the point of land above the junction of the rivers, which, as I was informed by Mr. Ichbaum, and other old citizens, abounded in ponds and sloughs, now filled up and built over. In the rear of the town the hills are near, and soon after reaching their summits the observer finds himself in the dry bed of what was once a small, shallow lake, tortuously stretching off to the north-east, under the name of East Liberty Valley. Its elevation, as I was informed by Edward

Miller, Esq., Civil Engineer, is one hundred and seventy-five feet above the Pittsburgh plain, which would make it about nine hundred and fifty feet above the sea. The hills which surround it rise about one hundred and fifty feet higher, that is, to the general level of the country. A deep stratum of loam with rich soil overspreads the bottom of this obsolete lake; on which huge water-worn bowlders are scattered, indicating the fact, that this locality belongs to a different geological and topographical region from that of the south side of the Monongahela River. Before leaving this spot, I may remark, that Judge Wilkins, who resides in its midst, assured me that intermittent fevers do not occur among its inhabitants, and that remittents are extremely rare. This exemption should perhaps be ascribed, in part at least, to the great length of time it has been cultivated, for an elevation of nine hundred and fifty feet, and a latitude of forty degrees thirty-five minutes, are not sufficient to countervail the morbific influence of a flat and fertile surface, abounding (originally) in organic matter, and adequately supplied with moisture.

When we look from the hills to the south of this locality, up the valley of the Monongahela, we see a deep ravine, with abrupt and closely-approximated hills, in harmony with the general character of the upper portions of the Ohio Basin on the south side of the river; but when we look down, to the north and north-west, upon the Alleghany River, we find it meandering through broad alluvial and diluvial bottoms, with hills of gentler slope. On examining these plains we soon discover that they are not (like those to the south) composed merely of the disintegrated strata through which the river has flowed, but abound in sand, gravel, pebbles, and bowlders, detached from rocks of a much older geological date, than the carboniferous, among which they are deposited; and have, like the bowlders in the dried-up little lake just described, been transported hither by vast currents from the north. Such is the valley which stretches up the Alleghany River from Pittsburgh, and through which the Pennsylvania Canal has been excavated. Three miles from the city, on the left bank of the Alleghany River, stands the United States Arsenal. The bottom over which the road to this military post lies, presents some brick-ponds, and is partially overflowed in ordinary river floods; but these spots are to the north-east or leeward of the city. Captain Harding, who commanded the station, and Doctor Day, an aged army surgeon, assured me, in 1847, that autumnal fevers are almost unknown among the soldiers and operatives of the arsenal; and the people of the adjoining village of Lawrenceville enjoy, I believe, nearly an equal exexemption. The road to the arsenal passes over a terminal basin of the canal, in the northern suburb of the city. The water in this basin, from the absence of an outlet, is stagnant, and foul in appearance; yet, as Doctor Addison and Doctor Speer assured me, it has not generated either intermittent or remittent fevers, in those who reside around it.

The bottom which has been described, lies on the east or Pittsburgh side of the Alleghany River; but below, a still wider bottom becomes developed on the opposite or right side, which continues for three miles down the Ohio.

This, as may be seen on the map, is the site of Alleghany Town. A narrow strip of this bottom lying along the shore, both above and below the junction of this river with the Monongahela, is so low as to suffer inundation, and displays a foul and wet surface, which, in some places, is pondy, though on a small scale. The canal which, by an aqueduct, supplies the basin on the opposite side of the river, continues through the upper half of this bottom, when it discharges its water into the Alleghany. In its rear, there is a higher terrace — an old or second bottom — which, like other plains of the same geological age along the Ohio River, abounds in rolled and polished fragments of the primitive rocks of the north. This terrace does not, however, extend back to the hills, which lie at the distance of nearly a mile, but soon declines into a kind of superficial valley, through which it is obvious the Alleghany, or a part of its waters, when of much greater volume than at present, once flowed to the Ohio, two or three miles below its present junction with the Monongahela. Of course this ancient bed is not as free from watery surface as that part of the plain which has not been thus cut down.

Immediately below the junction of the Alleghany with the Monongahela, near the right-hand shore, there were formerly two islands, the upper strata of which have been washed away till they are no longer visible, except when the river is low. The surfaces which are there exposed abound in sand. Opposite to them, at a short distance from the river, an oval eminence rises one hundred feet above the plain, and has been made the site of a public theological seminary. It was an island when a part of the Alleghany flowed to its north. Its composition is the same as that of the surrounding hills, of which it is at once a remnant and a monument.

A mile below is the village of Manchester, partly built on portions of the plain which are, to some extent, liable to submersion when the Ohio is up; and also retain water in shallow ponds, after rain. In proceeding farther down the river the higher terrace disappears, and the adjacent hills come nearer to the river. The surface of the lower bottom still remains so high as to escape all except extraordinary floods; but a permanent swamp overspreads much of its breadth, and stretches with it along the river, becoming wider as it advances. Near the upper end of this swamp the United States commercial hospital has been erected. Opposite the swamp is Bruno's Island — a part of the bottom cut off from the rest by the current.

From the junction of the Monongahela and Alleghany, the Ohio or common trunk takes a direction nearly north-west, with the hills on the south side approaching it closely for several miles from the city. Thus the south and south-west winds flow down upon Pittsburgh and its progeny of villages, from a terrace four hundred feet above them. When the west and north-west winds prevail, they come over the hospital-swamp, and bear its exhalations into the towns above; by which Manchester and the south-western part of Alleghany Town suffer much more than Pittsburgh; which is more remote, has the Alleghany River interposed to its windward, and is compactly built,— conditions favorable to protection against paludal influences.

All the physicians of Pittsburgh and Alleghany Town with whom I conversed, agree in representing that the intermittent fevers of this locality may be traced up to the low grounds and the swamp to the west and north-west; being more frequent near them, in proportion to the population, and diminishing as we recede from them. Doctor Smith, of Alleghany Town, assured me that, although there is much wet and foul surface about the termination of the canal, it does not seem to produce intermittent fever; so true is it that swamp is the prolific source of that form of fever, and that towns have great capacity for resisting it. Remittent fever prevails over the same tract with intermittent, and also beyond; for it occurs in Pittsburgh, where intermittents are now nearly unknown, and, indeed, seem never to have prevailed to much extent.

While the north-east and north-west winds, traversing the valleys of the Alleghany and Ohio Rivers, ventilate Pittsburgh and its villages very effectually, the winds of summer, from south-east to south-west, have but little power in that way; but, at the same time, they bring less of impure air than they carry into any other town on the banks of the Ohio.

In connection with ventilation, I must refer to the factitious atmosphere, generated in this locality by the combustion of stone-coal. Coal-Hill, the rampart on the south side of the Monongahela, abounds in strata of the very best bituminous coal, in horizontal beds, above the level of the city and its *faubourgs*. To this, in a great degree, may be ascribed the establishment of factories requiring fuel, for which this place has become so famous. Of their number it is neither possible nor necessary for me to speak; but the quantity of bituminous coal consumed in this locality is greater, I suppose, than in any other on the continent. The amount, as I am informed by Doctor Denny, is estimated at ten millions of bushels annually. As yet, very little of the smoke arising from these fires is consumed, and consequently it escapes in immense volumes, carrying into the atmosphere its carbonaceous matter, carbonic acid, carburetted hydrogen, and perhaps sulphurous acid, all of which hover over the city and its environs the longer, from the obstacles to free ventilation which the surrounding hills oppose.

As in other towns of the West, through the early periods of settlement, the people of Pittsburgh, previous to the year 1827, drank well-water; since that time they have drunk the water of Alleghany River, supplied through a system of hydrants. To this time, however, the inhabitants of Alleghany Town, nineteen thousand in number, and those of the other *faubourgs*, use well-water chiefly.

Pittsburgh is the oldest Anglo-American town in the basin of the Ohio. In 1754, the French from Canada built *Fort du Quesne*, at the junction of the two rivers which form the Ohio. In 1758, they were expelled by the colonists, and the name was changed to Fort Pitt. In 1760, the buildings for residence were commenced; and in 1765, a town-plot was surveyed. The present population of the city and its suburban towns and villages is estimated, as Doctor Denny informs me, at eighty-five thousand, of which a plurality, I believe, are Irish, either by birth or extraction.

CHAPTER X.

THE SOUTHERN BASIN, CONTINUED.

MEDICAL TOPOGRAPHY OF THE REGIONS EAST OF THE MISSISSIPPI: BASIN OF THE OHIO ON THE NORTHERN SIDE OF THE RIVER.

SECTION I.

BASIN OF THE ALLEGHANY RIVER.

I. A line drawn through the center of this basin, from Pittsburgh to the middle sources of the Alleghany River, would run about north north-east, traversing two degrees of latitude, and ascending through seven hundred feet of altitude, from low-water mark at Pittsburgh. In many places the immediate valley expands into broad alluvial and diluvial bottoms, abounding in the *debris* of primitive northern rocks, but in other places wild and rugged hills compress it on both sides. The country west of the river bears considerable resemblance, in aspects and altitude, to that west of the Monongahela, but is more broken. To the east of the Alleghany it has a sharper and loftier hilliness, which graduates into the Chestnut Ridge, and other outer ranges of the Appalachian Mountains; though the elevation attained is nowhere as great as that of the region in which the Cheat River branch of the Monongahela has its origin. All the large tributaries of the Alleghany, except French Creek, are found on its eastern side. The shorter descend from the western slopes of Chestnut Ridge; others originate in the valley between it and Laurel Hill; while some have their sources beyond the latter, in the western escarpments of the Alleghany range, and cut through both the other ridges. Of this kind is the Kiskiminitas or Conemaugh, which enters the Alleghany thirty miles from Pittsburgh, and by its valley affords a passage for the Pennsylvania Canal through both the Chestnut Ridge and Laurel Hill — as the valley of the Youghiogheny is expected to afford a way through the same for the Chesapeake and Ohio Canal. These hydrographical facts show that Chestnut Ridge and Laurel Hill are not boundary mountains of our Great Valley, but are really included in it. Its true limits are, in fact, the Alleghany Ridge in Pennsylvania and northern Virginia, while in the southern part of the latter state, and in North Carolina, the Blue Ridge is its actual terminus or rim. The medical etiologist of the Interior Valley has, then, within his own jurisdiction, a broad alpine region, running through eight degrees of latitude, with a mean elevation of fifteen hundred feet above the bed and banks of the Mississippi, to which it is parallel; and the time will come when a comparison of the two belts, in the physiology and diseases of their inhabitants, will be regarded as a work of deep interest. Unable to visit any part of the region lying between the Alleghany River and the Alleghany Mountain-crest, or to meet with publications illustrating its medical topography or diseases, I must content myself, at this time, with indicating it to others, as a field comparatively unexplored by the physician. Of the other, or western side of the Alleghany Basin, I can say something from personal observation and inquiry.

II. From Pittsburgh to Franklin, at the mouth of French Creek, the road, running nearly north, passes over a country of ridges with occasional plateaus. The streams have more of interval or bottom-land than those of the Monongahela Basin. The general elevation of the country is about the same as around Pittsburgh. The whole distance is within the carboniferous formation, but the seams of coal are thin, for the margin of the formation lies but a little further north. From Doctor Dewolfe and Doctor McJunkin, of the town of Butler, thirty miles from Pittsburgh, I learned that, although intermittent fever is almost, if not absolutely, unknown in the town (notwithstanding there is a stream and mill-pond close to it on the south-east), still there are parts of the country in which that disease occurs in a much more decided manner. Remittent fever is not uncommon, and often shows a leaning toward a continued type.

III. Franklin.—The site of this town, once the place of a French military post, is a beautiful diluvial terrace, at the junction of French Creek with the Alleghany River, on the south or right-hand side of the former, and more in connection with it than with the latter. The plain is extensive enough for a large town, and neither subject to inundation nor infested with swamps. Its elevation above the sea cannot vary much from eleven hundred feet, nor that of the surrounding hills from four hundred more, making their general level fifteen hundred feet. French Creek flows down an alluvial and diluvial valley, which, at an ancient geological period, conveyed a large river. Several years since it was locked and dammed, the effect of which on the autumnal health of the inhabitants was bad. From Doctor Gillet I learned that intermittent fever, generally of a tertian type, prevails in this valley every year; commonly mild, but sometimes accompanied with protracted coldness and reluctant reaction. It does not extend to the plateaus of the hills. Remittent fever is less common, and often terminates in the other variety, instead of a typhous condition. In the last week of July, I was shown cases of intermittent fever by Doctor Gillet.

IV. Warren.—Up the Alleghany for seven miles, to the mouth of Oil Creek, the river is closely compressed by the hills. Oil Creek flows through a broad valley. At its mouth the road ascends high and barren hills of conglomerate, the rock which underlies the coal basin,—from which we have now escaped, after having repeatedly entered and traversed it, from the

Tennessee River, in the thirty-fourth degree of north latitude. From the summits of this out-crop, the elevation of which cannot be less than seventeen hundred feet, we gradually descend, over plateaus and ridges, into the valley of the Alleghany, which, from this point, for a great distance down (as I was told), is very narrow, the river struggling through a labyrinth of hills, covered with pine, hemlock, and chestnut. Ascending the valley from this point, it continues narrow for several miles, when we approach the mouth of the stream called Broken Straw, where it becomes as broad as that of the Ohio. The elevation of this alluvial plain is eleven hundred and sixty-seven feet above the sea.* On passing this spot, the bottom contracts a little for six miles, when we reach the town of Warren, on the right or west bank of the river, in latitude forty-one degrees fifty minutes north, at an elevation of eleven hundred and eighty-five feet;† the conglomerate and sandstone hills around, attaining, by estimate, the altitude of sixteen or seventeen hundred feet. These hills, in every direction, are destitute of a single stratum of limestone, and the water which they supply is soft. Warren is situated on a beautiful semi-lunar bend of the river, within which, on the opposite side from the town, there is a low, broad, wooded bottom, subject to inundation. The site of the town is a diluvial terrace, elevated above high-water mark of the river; but having some portions of its back part swaley, from springs which burst out of the adjoining hill. Immediately above the town, the outlet of Chautauque Lake, called Conewango Creek, joins the river from the north. The water of both streams is dark-colored, a sign of its having flowed through or from tamarack swamps. Near their junction, there are patches of bottom, which are overflowed by the freshets of the Alleghany. Warren, the most beautiful of all the mountain villages, is one of the *emporia* of the pine-lumber trade. As to intermittent fever, Doctor Sargent and Doctor Irvine assured me that it is nearly unknown; nor does it occur on the broad bottom at the mouth of Broken Straw. Remittent fever prevails to a limited extent only. In a population of twelve hundred, there are, in some autumns, four cases at one time. They are so mild and manageable, that neither of the gentlemen had seen a fatal case for twelve years. Nor is it replaced by typhus fever, which is quite as rare as the remittent. It is not easy to assign a reason for the very different prevalence of intermittent fever at Franklin and this place.

V. Conewango Creek and Chautauque Lake.— In ascending the Conewango, which is but a mill-stream, its valley is seen to be as wide or wider than that of the Ohio, abounding in diluvial terraces of various elevations, and composed largely of pebbles and bowlders, many of which are granite, and have been transported thither from the north. For the first nine or ten miles the stream has a rapid fall. Then, suddenly, the valley widens to three times its previous breadth; the rapid creek becomes a deep and sluggish canal; broad, low, flat, and fertile bottoms spread out; and the adjacent hills exchange their rugged aspect for one of gentle rotundity, and,

* Reports on the Erie and Sunbury Railroad. By Ed. Miller, Civil Engineer.
† Ibid.

losing their oaks, and chestnuts, and whortleberries, present groves of sugar-maple, walnut, beech, and other trees of a like kind, with which white pines, as lofty and abundant as on the poorer soils, are strikingly blended. This remarkable transformation of surface and scenery discloses two facts:—*First*, That we have passed through the final out-crop of the conglomerate, and come upon the Devonian sandstone and slate, which have emerged from beneath; *Second*, That we are in the bed of an obsolete or drained lake, which was once connected with Chautauque Lake, but at a little lower level. Through this dry lacustrine bed, the Conewango, which at times overflows portions of it, has an extensive meandering and circuitous course, in sight of which the road is continued over a series of high diluvial terraces and low slate ridges, until it reaches JAMESTOWN, in the state of New York, at the eastern end of Chautauque Lake. The whole distance from Warren to this place is twenty miles, and the dividing line between Pennsylvania and New York crosses nearly equi-distant between them.

I have spoken of the Conewango as an outlet of Chautauque Lake; but it has an independent existence, and originates to the north-east of that lake, above the latitude of forty-two degrees, whence it descends into the obsolete lake-bed, and unites with the outlet of Chautauque Lake. The bottom-lands of this large creek and its tributaries, before it reaches that locality, are broad and depressed, covered with hemlock, and subject to inundation. They bear, in fact, a close resemblance to the wide, low, and wet interval lands of many of the smaller streams in the cretaceous and tertiary formations of Alabama and Mississippi, near which, as we have seen, autumnal fevers of the most malignant character are generated.

Chautauque Lake is twenty miles long, and from one to three or four broad. Its figure is serpentine; its western extremity reaches within fifteen or twenty miles of Lake Erie; the country around it slopes beautifully down to its margin; in some places terminating in a bluff bank, in others sinking to the level of the lake before reaching it, and thus creating swamps, into which rivulets discharge their waters, and on which those of the lake are sometimes blown. On a small stream called Goose Creek, which meanders through one of these swamps, I saw a mill-dam with a pond of the foulest aspect. The altitude of this little lake is twelve hundred and ninety feet above the level of the sea, and seven hundred and twenty-five above Lake Erie, although so near it. The average hight of the surrounding ridge-summits, is estimated by Doctor Hazeltine, who resides upon one of them to the south of the lake, at two hundred and sixty more, or fifteen hundred and fifty above the sea; which may be taken as the summit-level of the long belt of rolling table-land that stretches from a point considerably east of Chautauque Lake to an undefined termination far west; resting on the Devonian sandstone and slate, as on a broad terrace; and constituting, beyond comparison, the most interesting region to be found at the same elevation east of the Mississippi; with the sources of which river it corresponds in elevation. It is worthy of remark, that bowlders of granite of great size, as well as deposits of rolled pebbles, are found in the superficial valleys, and even on the highest ridges of this table.

JAMESTOWN, on the left-hand bank of the outlet of the lake, is built on the gentle slope of a low hill, and is free from any contiguous swamp, except some small tracts produced by a mill-dam near the town. The settlement of this place began in 1815. Its population is about two thousand.

VI. Let us now turn to the autumnal health of this extensive and interesting locality. At a corresponding elevation among the waters of the Kenawha and Monongahela, we found neither lakes, ponds, swamps, nor alluvial bottoms, of any considerable extent, and could not, therefore, ascribe the limited prevalence of autumnal fever there to mere elevation; here, however, we have the whole of these surface-conditions in latitudes the same with regions lying to the west, which are seven or eight hundred feet below this locality; which regions, as we shall hereafter see, are greatly infested with autumnal fever. The difference, then, between this spot and others west of it, in regard to autumnal fever, can be ascribed only to difference in elevation. Let us inquire how great this difference is. From Doctor Hazeltine, who came hither at the commencement of settlement, I learned that, for the first three years of his residence, he did not see a case of intermittent fever. The disease then made its appearance, and prevailed moderately for three years, and then began to decline. The type was mostly double tertian. Other diseases during that period displayed something of a periodical character, and several enlarged spleens fell under his notice. Through the same period, remittents occurred, and were prone to end in agues. They, also, became fewer, *pari passu* with intermittents, and for several years he had not seen a case of either. He lived in Jamestown, but his observations were extended over the whole locality.

From Doctor Elderkin, who has long resided on the margin of the Goose-Creek swamp, near the mill-pond which has been mentioned, I learned that *occasional* cases of both intermittent and remittent fever occur in their vicinity; but neither disease has ever *prevailed* in that locality, although so well-fitted, topographically, to produce them; and in latter years their occurrence has become still rarer.

By Doctor Axtell, who had resided for twenty years in the obsolete lake-bed south of Jamestown, and practiced medicine there for the last five years, I was informed that, throughout the whole period, he had scarcely heard of a single intermittent. All that he had seen, amounting only to three or four, had been contracted elsewhere. Remittent fever occurs, but with great rarity.

These various statements were strengthened by the observations of Doctor Hazeltine, junior, and of gentlemen out of the profession, as communicated to me on the spot. The Conewango and its branches, before that stream enters the obsolete lake-bed which has been described, flow through wide alluvial lands, abounding in hemlock swamps. In one of these valleys, that of the Little Conewango, stands the village of RANDOLPH, fifteen or eighteen miles north-east of Jamestown; at which, I was assured, they never have either intermittent or remittent fever. Nearly forty miles farther to the north-east, in latitude about 42° 20′, at Ellicottville, on the banks of Great Valley Creek, a tributary of the Alleghany, the elevation being about fourteen hundred feet, I was assured by Doctor Williams, who had resided there nineteen years, that intermittent and remittent fevers are unknown; and Doctor Stanton, after a shorter residence, confirmed the statement, except that he had seen what turned out to be continued fevers, commence with obscure remissions.

We find, then, that in the latitude of 42° N., the topographical conditions which originate autumnal fever, are nearly overcome by a mean altitude of fourteen hundred feet; but we have previously seen that, in the basin of the Kenawha, among the mountains of Virginia, at an elevation of eighteen hundred feet, Professor Rogers saw many cases of intermittent fever. This is to be ascribed to the difference of latitude, that locality being about four degrees farther south than the table-land in the vicinity of Chautauque Lake.

VII. French Creek. — The extreme sources of French Creek are hard by Chautauque Lake, on the rolling table-land just described, and also within a few miles of Lake Erie. Its course is first to the south-west, and then to the south-east, and the town of Meadville is included in the bend thus formed. Its eastern tributaries interlock with those of the Broken Straw and of Oil Creek, before mentioned as affluents of the Alleghany, which they join between Franklin and Warren. The elevation of this little region is about fifteen hundred feet: and many of the summits present extensive tamarack swamps,* but of its liability to autumnal fever I cannot speak. As French Creek descends from this elevation, passing near Waterford, the old French post of Le Bœuf, it appears like a dull, dark canal, meandering through wide interval lands, abounding in hemlock swamps, and in many places overspread with drift and bowlders from the north. The adjacent rounded hills are composed, like those near Chautauque Lake, of Devonian slate and sandstone. With this character it continues to Meadville. From that town down to Franklin, at its junction with the Alleghany, the valley of this creek presents wide alluvial bottoms, but the people living on them were generally exempt from autumnal fever: in the language of Doctor Ellis, that disease was scarcely known. During the years 1832, 1833, and 1834, however, the series of locks and dams already mentioned under the head of 'Franklin,' was constructed, converting the river into pools as far up as Meadville. The (apparent) effect of this proceeding was the generation of intermittents and remittents, and their annual prevalence to such an extent, along the whole line of pools, that in 1843, the inhabitants destroyed all the dams. But the autumnal sickness continued to recur, and in 1844 spread on the neighboring hills, many cases presenting a congestive or malignant character. In 1845 and 1846 a similar state of things returned; but in 1847, the year of my visiting this locality, the fever was replaced by dysentery; many cases of

* Report on Erie and Sunbury Railroad. By E. Miller, Civil Engineer.

which, however, demanded the same treatment as intermittent fever. The average hight of this valley is about eleven hundred feet above the sea — its latitude 41° 30′ N. According to Doctor Ellis, in the valley of French Creek, above Meadville, where locks and dams were not erected, and both the elevation and latitude are something higher, autumnal fever scarcely occurs.

VIII. Meadville. — This is the most noted town within the basin of Alleghany River. It stands chiefly on a low, flat, left-hand bottom of French Creek, but has also extended upon a higher diluvial plain. A small stream traverses the lower terrace. Two or three miles above the town French Creek has been dammed, and a canal, supplied from the pond thus created, passes through the town, and is afterward, by a great *detour* to the west, made to terminate in Conneaut Lake, of which an account will be given presently. In summer and autumn nearly all the water of French Creek passes along this canal, so that its bed, immediately to the south-west or windward of the town, would be nearly dry, but that a tributary enters from the west, below the dam. The elevation of the lower part of the town site is eleven hundred and forty-five feet; that of the surrounding hills (composed of Devonian slate and sandstone, capped with conglomerate) is, on an average, four hundred and fifty-five feet higher, making their altitude above the sea sixteen hundred feet.* Its latitude is about 41° 40′ N. As to autumnal fever, I was assured by Doctor Ellis and Doctor Yates, who had resided in the town nearly twenty years, that intermittent fever was almost unknown until after the excavation of the canal which passes through it. The water was let into it from the dam above the town, and suffered to stagnate in it, for the canal was not used. Then it was that the fever began to make its appearance, and has continued to return annually ever since.

We have seen, in Sec. VIII, of Ch. IX, that the erection of locks and dams on the upper part of the Kentucky River, although three degrees farther south, and six hundred feet nearer the level of the sea, was not followed by an increase, but a diminution of autumnal fever. To what shall the difference of effect be ascribed? I know of nothing but the comparative topography of the two valleys. The upper Kentucky River flows through a rocky trough, with deep shore-waters, and margins generally free from organic matter; but French Creek runs in a broad alluvial valley, many parts of which were doubtless overspread with sheets of shallow water resting on a soil abounding in decomposable materials.

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* Rogers's Third Annual Report on the Geology of Pennsylvania.

SECTION II.

BASIN OF BEAVER RIVER—CONNEAUT LAKE—BEAVER AND ERIE CANAL.

I. General Description—The region designated by these titles, lies west of the Alleghany Basin, in Pennsylvania, and east of the Muskingum Basin, in Ohio. It brings us upon a lower and leveler surface; which is, in fact, a continuation on the north side of the Ohio, of the region between Brownsville and Wheeling. The eastern portions of this basin have a hill-elevation on the Ohio River in the south, of twelve hundred feet, rising gradually, as we go back, to fifteen hundred, but declining to eleven hundred, and even one thousand, as we pass to the west from Butler and Crawford counties, Pennsylvania, into Trumbull county, Ohio. The water-levels of the canal and principal branches of the Beaver, rise from seven hundred to eleven hundred feet.* We shall see that these details make a necessary element of the medical topography of this region. East of Beaver River, the more elevated surface is rugged; west of that river it becomes much leveler, and presents us with the eastern extremity or commencement of a flat water-shed, which extends westwardly (gradually becoming lower) until it reaches the sources of the streams which flow into the Mississippi.

The Beaver, and its great elementary branches Shenango and Mahoning, flow through wide valleys which abound in alluvial and diluvial terraces. Many of them originate in extensive swamps, which impart a dark color to their water, and large tracts of bottom-land, annually overflowed, are left with sloughs and shallow ponds. Autumnal fever prevails throughout.

II. Canals and Conneaut Lake.—A canal ascends the Beaver Valley, from its junction with that of the Ohio, thirty miles below Pittsburgh, to the town of New Castle, about thirty miles up, where the Mahoning, the Shenango, and the smaller Neshanock unite. The common trunk there bifurcates; and while the western branch passes up the Mahoning for Cleveland, the other continues up the Shenango, directly north, to the town of Erie. On its way it passes hard by the western end of Conneaut Lake, which is on the summit-level, and supplies both extremities of the canal with water. Of the damming-up the outlet of this lake, and the introduction of water by a feeder from above Meadville, I have spoken in the last Section. This proceeding, as Doctor Ellis informed me, raised the surface of the lake eleven feet, and caused the overflow of its banks with shallow water to the extent of several thousand acres; much of which, in summer and autumn, when the streams supplying the lake were low, was laid bare by the drawing off to supply the canal. At the same time, the water in the broad alluvial outlet of the lake became stagnant, from the arrest, by the dam, of the current into it. In addition to this, near the south-west portion of the lake, there was a tree-swamp through which the Shenango passes, and a dam was thrown across both the stream and the lower or south end of the swamp, the trees on which

* Pennsylvania and Ohio Geological Reports.

were cut down. In this way a shallow supplementary reservoir was created.

The effects of this breaking-up of the natural relations between the land and water, were of the most disastrous kind, and by no means limited to the inhabitants living near the margins of the water, but were felt for several miles off, in all directions. They were, however, much worse on its shores than at a distance. In visiting this locality with Doctor Ellis, we came to the village of Evansburg, near the dam at the head of the natural outlet of the lake, and found it literally depopulated. But two or three persons were seen in its streets. In continuing our drive beyond, we passed through the midst of deserted plantations; where, previously, as in the village, the inhabitants had enjoyed good autumnal health. When we reached Hartstown a village on the Shenango, at the other dam, Doctor White confirmed all that I had been told, and added many details concerning the sickness of that part of this locality. While there I met with Doctor Bardwell, of Harmansburg, a village on the canal near the north-west extremity of the lake, who gave me a similar account; and has since, by letter, added, that the fevers and dysenteries of summer and autumn had been rendered most malignant; being accompanied by sloughing or gangrenous ulcers, hemorrhages, and a fatal sinking of the vital powers. He could not decide which had been most pernicious, the shallow inundation of dry land, or the draining of swamp-surface into the canal, which had taken place in some parts of this devoted locality; which, it is proper to add, lies in north latitude 40° 35′, and has an elevation above the sea of eleven hundred feet.

III. Mercer.—Thirty miles south of Meadville and Conneaut Lake, stands the town of Mercer, on hill land, where the Neshanock has its sources, and whence it flows to the south-west, and joins the Shenango, at New Castle. From the valley of this stream, which makes its way through strata of crumbling shale and soft sandstone, within the coal basin (into which we have returned), there arise exhalations, which generate many cases of autumnal fever, both in and around the town. Doctor Magoffin, long resident there, has been accustomed to meet with malignant intermittents, and has seen dysentery, palpitatio cordis, and cephalalgia assume a distinctly periodical character.

IV. Pulaski.—This village is seated on the left bank of the Shenango, which has alluvial bottoms. The canal passes through it, and there is, also, a dam across the river, creating a pond of remarkably black water. Doctor Wood, who came to the village in its infancy, thirteen years before my visit, informed me, in 1847, that for several years intermittents were unknown. The public works, which I have mentioned, were then constructed, and intermittents began to appear, and have spread over the adjoining hills. Mr. McGuffey, who resides a mile above the village, on the west or windward side of the mill-pond, informed me, that his family occupied that spot for thirteen years before a case of intermittent fever appeared among them, and it then *began in the spring of the year*.

V. New Castle.—From Pulaski to New Castle, ten miles, the broad alluvial and diluvial valley of the Shenango has, in latter years, become infested with intermittents. The canal has caused an overflow of many low spots. New Castle stands on a dry plain, at the junction of the Shenango and Neshanock. Doctor Cossitt and Doctor Gamble informed me that intermittents had greatly increased in latter years.

From these various testimonies it would appear, that the excavation of the Beaver and Erie Canal has been productive of much injury to the health of the inhabitants.

SECTION III.

BASIN OF THE MUSKINGUM RIVER.

I. Transition from Beaver to Muskingum River.—Although the sources of these rivers interlock, on the summit-level between the Ohio River and Lake Erie, their mouths are one hundred and fifty miles apart. Through that distance the course of the Ohio is south south-west. Its bottoms are of the ordinary breadth and elevation for the upper part of the river, and do not merit further notice. On one of them stands the town of Steubenville, of which I am not able to say anything. The adjacent zone of upland demands a more extended notice. It is very narrow, for the Muskingum River presses it on the west. The counties which are comprehended in it, are Columbiana, Jefferson, Harrison, Belmont, Monroe, and part of Washington; all in the state of Ohio. In topographical features this zone is an extension of the western part of the lower basin of the Monongahela River, in Pennsylvania and Virginia. The town of Wheeling lies nearly opposite its middle. Most of its streams flow into the Ohio; but the western part of each county, except Jefferson, gives origin to creeks, which, taking a western direction, with a sluggish current, become tributary to the Muskingum. They are flush in rainy weather, but dry up, or fall very low, in summer and autumn. Those of Columbiana county are the most permanent. The springs are sufficiently numerous, and tolerably durable, but never copious: they commonly burst out above or below the coal seams. There are no ponds or swamps, and the bottom-lands are, in the main, too narrow and destitute of alluvion to exert much sinister influence. On the whole, this long narrow belt is one of the dryest in the Ohio Basin. Its surface is everywhere rolling or steep-hilly, with an average summit-elevation of eleven hundred feet; while some parts of Belmont county rise to the altitude of twelve hundred and eighty-four feet, and are, therefore, among the highest in the state of Ohio.

Doctor Thomas Carroll, to whom I am indebted for much of this information, and who practiced his profession for seventeen years in this district, and has written on its topography and diseases,* informs me, that in the whole time he did not see more than four or five cases of intermittent fever;

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* Western Journal, Louisville, January, 1842.

and those, he thinks, were contracted elsewhere. Remittents, however, are not so rare, and often assume a typhous character. In his paper he remarks: "Take the country for twenty miles west of the Ohio, and extending from the Pennsylvania line to Marietta, and, I apprehend, no district between it and the Mississippi, has so great an exemption from these fevers; and no country could be much better calculated to restore to perfect health constitutions partially broken down by remitting and intermitting fevers." It is interesting and instructive to note this autumnal salubrity, in connection with dryness and elevation of surface. The mean latitude of the locality is 39° 30′ N., in which parallel, at a lower level, and with a different kind of surface, intermittent and remittent fevers prevail, in a very decided degree as they also do along Beaver River and its branches, up to Conneaut Lake, a degree further north.

II. THE MUSKINGUM VALLEY UP TO ZANESVILLE. — From Doctor Hildreth, of Marietta, I have received the following notices of the topography of the lower part of the Muskingum Basin. "The river from its falls, at Zanesville, passes nearly south-east, through a hilly region. In some places, its shores rest against the foot of the hills, or approach so near, that there is between them but a narrow strip of alluvion. In others, the bottoms expand to the width of half a mile, but, on the whole, are much narrower than along the upper portions of the river. The back parts of most of these bottoms are lower than the front, and in many places, covered with water from the spring rains, or the river freshets, by which marshes and ponds are left through summer and autumn. In the progress of settlement many of these tracts have been ditched and drained, whereby a great diminution of intermittent and remittent fever has been effected.

"The whole of this portion of the river has been subjected to slack-water improvements, on the effects of which I have made the following observations. Where the banks are high and bold, the autumnal health of their inhabitants has been improved. The heads of islands and sand-bars, which, formerly, were exposed to the action of the sun, as the river fell in August and September, are now kept covered with water. Where the banks are low, and the back parts of the bottoms swaley, the keeping up of the surface of the river, by the dams, prevents the surface-water from flowing off after the rains of spring; and remaining to be slowly evaporated during the hot weather, the people are made more sickly. On the whole, however, the dams have done more good than harm to the health of the inhabitants. It has not been observed, that those who live near the dams, over which the water falls, are more unhealthy than those who live between them, which is contrary to what was the popular opinion. The inhabitants of the hills, only a few miles from the river, are never affected with intermittents, unless they sojourn on the bottoms. As to the geology of the lower part of the basin, from Marietta for some distance up, the hills are composed of soft argillaceous sandstone, of the coal formation, and the bottoms in a great degree of their *detritus*. Beyond this, we come to an out-crop of limestone from the south, which stretches off east and west, in its line of bearing, with a width of twenty or thirty miles. This rock gives a very different character to the hills, which, instead of being clothed with oak timber like those of the sandstone formation, produce sugar-tree, beech, poplar, and other trees and shrubs, similar to those which are found on the bottoms."

The lower or southern part of the Muskingum Basin is uncommonly narrow, as it is encroached upon by the Ohio to the east, and Hocking River to the west.

III. UPPER MUSKINGUM BASIN.—Immediately above Zanesville, this basin spreads out to the east and west, until it becomes broader than any other in the state of Ohio; and is watered by many beautiful streams, which flow through wide alluvial and diluvial bottoms, abounding in organic matter. The largest of these streams are the Licking, which enters the Muskingum on its west side opposite Zanesville, and the Walhonding and Tuscarawas, which, by their union at Coshocton, form the Muskingum. The two latter originate on the table-land which divides the waters of the Ohio from those of Lake Erie, about north latitude forty-one degrees. This table-land may be regarded as a continuation, at a lower level, of the table-land around Chautauque Lake, at the sources of the Alleghany River, in New York. This portion of the Muskingum Basin lies north of the coal formation, on Devonian slate and sandstone, and has a general elevation of one thousand feet above the level of the sea. It contains many ponds or small lakes, and numerous cranberry swamps, some of which are of great extent.

The diluvial deposits, consisting of matters brought by ancient currents from the north, are in this region very broad, and not confined to the valleys (which near the sources of the streams are shallow), but bury up much of the Devonian or sub-carboniferous strata of the uplands. In entering this region, we arrive, distinctly, at the prairies, which, as we shall hereafter see, stretch westwardly to the Mississippi River, becoming greater in extent, proportionally to the woodland, as we advance. The whole of the upper Muskingum Basin is not level. The greatest flatness of surface is found in the northern range of counties — Stark, Wayne, and Richland. South of these, as we approach the conglomerate which underlies the coal, the country becomes broken, and swales and marshes are fewer in number; the streams, however, continue to flow through wide bottoms, which in many places are liable to inundation. As a general fact, it may be stated, that intermittents and remittents prevail over every part of the upper basin.

After these general views, we must bestow some attention on a few localities.

IV. OHIO AND ERIE CANAL.— This canal, which passes from Cleveland, on Lake Erie, to Portsmouth, on the Ohio River, enters the upper Muskingum Basin, at the sources of the Tuscarawas, in the north, and passes out to the south, after traversing the valley of Licking. As it was excavated between 1825 and 1830, it is not practicable, at this late period, to ascertain the modifications of autumnal health which attended or followed that operation; and, as it has been carried along streams, through alluvial grounds, its present influence is so mixed up with theirs, as to defy analysis. As to the health of the boatmen, I was assured by a number, that they are less subject to autumnal fever than the people who reside on the banks of the canal. Their statements seemed to be made in good faith; and if we admit the fact, we may conjecture, that the watery surface over which they constantly live exerts a protective influence. Where the canal leaves the Licking, to pass into the Scioto Valley, there is an extensive artificial reservoir, designed to supply water to the canal, of which it will be proper to say something.

The Reservoir.—The latitude of this receptacle is very near forty degrees. Its elevation above the sea eight hundred and eighty-nine feet. Its area several thousand acres. A part of this reservoir was a natural lake, the rest a wooded cranberry swamp. The surrounding embankment is composed of earth, taken from the surface without, so that there is an exterior belt of low ground, kept wet by percolation from the reservoir. From a portion of the inclosure the forest was removed before the water was let in, but left undisturbed on the other. Through the first summer after the surface was submerged, the trees maintained their verdure; in the second, they had a sickly aspect; and before the ensuing spring, were dead. When I saw them in 1840, they were dropping their decayed limbs into the water, and many of them had been blown up by the roots. The landscape wore a peculiar and melancholy aspect of desolation. By Doctor Ewing, and other gentlemen of the neighboring village of Hebron, I was assured, that the people in the vicinity of the reservoir have suffered less from autumnal fever, since its construction, than while the spot was a swamp. The reservoir is chiefly supplied by the South Fork of Licking River, most of whose waters are turned into it. Before this diversion, that stream, in the spring of the year, overflowed its bottoms, but not since; and the people who live near it have become healthier in autumn than formerly.

The contrast of this statement, with that in the preceding section, concerning the Conneaut Reservoir, is so striking, as almost to raise a doubt as to the accuracy of both; yet both were made by respectable physicians. Admitting their truth, we are admonished to regard some of the problems of medical hydrology, as more difficult of solution than is generally supposed.

V. Canton. — The upper Muskingum Basin has many flourishing towns, of which Granville, Newark, Mount Vernon, Mansfield, Wooster, Coshocton, Massillon, and Canton, are the principal; but my notes are too imperfect for use, except in reference to the last, which is not the most important; but its medical topography and autumnal diseases may be taken as representatives of the whole; for they are all built on alluvial or diluvial terraces.

Canton stands in latitude 40° 38′ N., at an elevation of about nine hundred feet above the level of the sea. The site of the town is the point of land immediately above the junction of the East and West Forks of Nimishillin Creek, an eastern tributary of the Tuscarawas. The plain is diluvial, and above the reach of inundations by the streams; but the immediate banks of the streams are alluvial, wet, and swampy, while their currents are sluggish. These low terraces were heavily wooded, when Doctor Stidler arrived.

in the year 1828; but the trees have since been mostly felled, and the ground has become dryer. Much of the drift on which the town is built, has been brought from regions of primitive rock in the north, and rests on Devonian or sub-carboniferous sandstone. The country around is inclined to levelness, and abounds in natural ponds, mill-ponds, and swamps. In the early period of Doctor Stidler's practice in this place, both the village and the surrounding country were greatly infested with intermittents and remittents, which were sometimes malignant; but, under the influence of clearing and cultivation, they are less prevalent. Still, in conversation with Doctor Whiting, on the 16th of September, I found that he then had thirteen patients with intermittent fever, all residing, however, in the country, on the borders of streams or marshes. He described cases of as malignant and fatal a type, as any which are generated on the banks of the Cahawba or Pearl River, eight degrees farther south, and six hundred feet nearer the level of the sea. Doctor Estep had observed that remittents were more frequent in the town than intermittents, and prone to become continued.

VI. ZANESVILLE. — This city, the population of which, with its *faubourgs*, West Zanesville and Putnam, is about nine thousand, stands in N. Lat. 39° 59′, on a high diluvial terrace, which makes the east or left bank of the Muskingum River, adjacent to its falls, and opposite the mouth of its large tributary the Licking. The elevation of the plain is seven hundred feet above the sea. It lies within the coal basin, and is surrounded by hills, which rise about two hundred feet higher.* The village of West Zanesville consists of a single street, above inundation, with hills in its rear. The town of Putnam stands on a wider bottom, which is also exempt from submersion, and is bounded by hills. Between them, near the mouth of Licking, some small portions of bottom are liable to occasional inundations. At the falls there are a dam and lock, from which a mill-race or canal has been dug across the most depressed part of the Zanesville plain, and gives some wet surface in the south-western suburbs of the city. The inhabitants are supplied with excellent well-water, and also with river-water, by a hydrant system. Their chief fuel is coal. The country around is broken, dry, and, except along the river, deficient in fertility. From Doctors Moorehead and C. C. Hildreth, whose communications have corrected and enlarged my personal observations, I learn that autumnal fever scarcely occurs in this locality. Through a period of fifteen years, the latter never saw it assume an epidemic character, and most of the sporadic cases had evidently been contracted elsewhere. Near the river margin of the plain, however, in the south-western suburb, where, as we have seen, there is some wet ground, Doctor Hildreth has observed the people to be more affected with that fever than elsewhere.

VII. LICKING RIVER demands a notice. Near its mouth there is a dam, and a second, sixteen feet high, a few miles up the stream. The latter has created a pool several miles in length, from which, when the river is in flood, considerable tracts of alluvial terrace are overflowed. In one of these bot-

* Ohio Geological Reports.

toms, moreover, there is a pond. According to Doctor Moorehead, to whom I am indebted for these facts, there is in this locality a decided prevalence of autumnal fever.

The *Muskingum Pool*, formed by the dam at its falls, nine feet high, extends up to the town of DRESDEN, a distance of fifteen miles. According to the observations of Doctor Moorehead, this pool has not had the slightest effect in producing autumnal fever; but beyond it, at and above Dresden, where there are extensive bottoms, which suffer inundation and abound in stagnant surface-water, the inhabitants are infested with intermittent and remittent fevers. The facts connected with the Zanesville locality are of some importance in reference to the remote cause of autumnal fever, and recall those observed at Pensacola (*pp.* 52, 53). The summer heat and the atmospheric moisture are both as great, or even greater, in Zanesville, than up Licking Creek, or along the Muskingum above Dresden; and yet the two latter localities are much sicklier; indicating that something beyond heat and humidity is required to generate autumnal fever.

VII. MARIETTA.—The town of Marietta is built on a bottom common to the Ohio and Muskingum Rivers, immediately above their junction. A small stream from the hills to the east, traverses the town-plat, and discharges its waters into the Muskingum. When the rivers are high, their waters are backed up this creek, and some portions of the plat are overflowed. The greater part of the plain is, however, above the highest floods. On the opposite side of the Muskingum another and lower bottom constitutes the site of the newer town of HARMAR, in early times the site of a fort. Between the two towns a dam and lock have been erected in the Muskingum, creating a pool, which extends several miles up the river, and makes a part of the slack-water system which has been described. Up the Ohio, above the town, there is an extensive and highly cultivated bottom; nearly opposite the town is the lower end of a long island.

The low-water elevation of the Ohio at the mouth of the Muskingum is five hundred and sixty-six feet above the level of the sea, or two feet higher than the surface of Lake Erie. The plain on which the town is built rises from fifty to eighty feet higher, giving it an average of six hundred and thirty feet above the sea; while the surrounding hills, present a mean elevation of two hundred and seventy more, or an altitude above the ocean of nine hundred feet. These hills are composed of the soft sandstones and shales of the carboniferous formation. The latitude of the town is 39° 25′ N.,—its longitude 81° 29′ W.

Marietta enjoys the distinction of being the first spot at which an Anglo-American settlement was made in the northern half of the Ohio Basin. Here, on the 7th of April, 1788, began the civil and political existence of the North-western Territory, since divided into the states of Ohio, Indiana, Illinois, and Wisconsin. Its original inhabitants were a colony from Massachusetts, and as the town has not grown beyond a few thousand, it presents no varieties of physiology.

In the early period of its settlement, this locality was infested with autumnal fever up to the average degree; but with the progress of cultivation and civil existence, that malady has suffered the usual abatement.

SECTION IV.

THE REGION BETWEEN THE MUSKINGUM AND SCIOTO RIVERS: HOCKING RIVER.

I. From the mouth of the Muskingum to that of the Scioto, the distance by the Ohio is one hundred and seventy-five miles, while many of the upper tributaries of those rivers meander in the same localities. For a considerable distance they run nearly parallel; then the Muskingum diverges to the east, and enters the Ohio; which afterward flows far to the south-west and then to the north-west, before the Scioto, by a directly southern course, unites with it. The region between the lower portions of these two rivers is that now under examination. It has a long connection with the Ohio river; lies, as it were, in a great bend; but does not run very far back. If not the most elevated, it is the most rugged and sterile portion of the state of Ohio. Geologically, it constitutes a part of the brim of the great Appalachian coal basin; and when we pass out, at any point between north and west, we leave that formation and come upon the Devonian conglomerate sandstone and slate, which dip to the south-east, beneath the coal measures. This district abounds in iron, salt, and coal; and, of course, embraces large classes of operatives, exposed to whatever etiological influences belong to their respective pursuits. The principal river of this region is the Hocking, which, originating near its northern margin, where the surface is comparatively level, takes a south-east course and unites with the Ohio not far below the Muskingum. The alluvial bottoms of this tortuous stream, hidden, as it were, for much of its distance among the hills, are wide, and many of them so low as to be subject to submersion when the river is swollen. The next in size, and only other considerable stream, is Racoon River, which joins the Ohio much lower down than the Hocking. It likewise is skirted with broad low bottoms; which is also the case with a still smaller tributary, Symmes' Creek, which enters the Ohio further down.

All these alluvial valleys are infested with intermittent and remittent fevers; while the hill-country, generally, is almost exempt, especially from the former. A few words concerning two or three towns of this region, must suffice.

II. LANCASTER.— This town is built on the left bank of the Hocking, near its source. The site is an alluvial plain, rising upon high diluvium. On the western or right side of the river, there was a low prairie, in which the stream meanders with a sluggish current. A canal now passes through the town. The substratum is Devonian slate. Autumnal fever formerly prevailed here to a decided degree, but has long been on the decline.

III. POMEROY.—The site of this town is a narrow, Ohio-river terrace, encroached upon, in the rear, by soft, sandstone, mural bluffs. The terrace is above high-water mark. On the opposite side of the river, there is a wider and lower wooded bottom, in which there are some ponds. Two miles below the town, the terrace expands into a considerable plain, some portions of which are subject to inundation. Near the upper part of this plain is the mining village of Coalport, inhabited almost exclusively by the operatives who dig for coal in the adjacent hill. In the new town of Pomeroy autumnal intermittents are few and simple; and the people of Coalport are almost as exempt; but the inhabitants of the wide bottom below them are subject to that disease.

IV. GALLIPOLIS.—This old, and, originally, French town, stands twenty miles below the last. It was settled in 1791, by immigrants from Paris. Its site, very nearly in N. Lat. 39°, is a high and ample alluvial or diluvial terrace, so level that, in its natural state, the surface was pondy. Above the town there is a wide and lower bottom, the margin of which near the river is dry, but further back there are ponds and swales, especially in the vicinity of a small stream called Campaign Creek, which there enters the Ohio. In this part of the locality, as I was told by Doctor Maxon and Doctor Hibbard, autumnal fever is much more prevalent than in any other. Immediately below the town, a creek, known by the name of Chickamargo, enters the Ohio, having alluvial bottoms, which are subject to inundation when the river is in flood. Six or eight miles to the north-west of Gallipolis, Racoon River and Campaign Creek approach within a few miles of each other. The table-land between them is called the PINE PLAINS, and includes the village of PORTER. The streams have alluvial bottoms, portions of which are liable to submersion. From Doctor Sisson, one of the physicians of this village, I learn that autumnal fever invades every part of the plain, not even sparing the village.

Yellow Fever.—Gallipolis is the only town of the Ohio Basin which has been charged with generating yellow fever. As much depends, in reference to the origin of that disease, on the truth of this imputation, it is necessary to inquire into the proofs. The plain on which the town is built was covered by a heavy forest when the Parisian immigrants arrived, and its wet surface was charged with organic matter. As the trees were cut down, and the sun admitted upon the surface, the new-comers fell sick of the fevers which everywhere appear under such conditions, in the latitude and at the elevation (about six hundred feet) of this place. The summer and autumn of the year 1797, seem to have been seasons of great mortality; during which Mr. Ellicott* arrived there on his voyage to Natchez, and reported to the editors of the New York Medical Repository, besides recording it in his journal, that the disease was yellow fever. Previously, and about the time of his visit, that fever had prevailed in Philadelphia and New York, and was held

* Journal of Andrew Ellicott, Commissioner for surveying the boundary between the United States and Florida.

by many physicians to be only the highest grade of our indigenous autumnal fever. At that time the malignant or congestive remittents, with which we are now familiar in the West, had not fixed the attention of the settlers; who, before the invention of steamboats, did not seek the river-bottoms, as they have since. Mr. Ellicott did not describe this fever in such terms as to show that it really was identical with that which prevailed on the Atlantic coast. In looking at the whole matter, the proofs seem to me insufficient to sustain his declaration; and I suppose the cases which led to it were examples of what is now known over the West and South-west as the malignant remittent fever of the country. To this conclusion I am the more inclined, from having witnessed the autumnal fevers of sickly localities, on the banks of the Ohio, since the year 1800, without having seen a prevalence of yellow fever, though occasional cases have closely resembled that disease. It is the more important to be careful in the examination of this isolated epidemic, of (so called) yellow fever, inasmuch as the adoption of Mr. Ellicott's report, precludes all further inquiry as to the local or indigenous origin of that disease; I will, therefore, add, that the distance from the sea, and the elevation above its surface, not less than the rural instead of urban character of the infant village, all militate against the conclusion that the epidemic was yellow fever.

SECTION V.

BASIN OF THE SCIOTO RIVER.

I. General Views.— The Scioto is the longest and most central river of the State of Ohio. Its sources interlock with those of the Sandusky of Lake Erie. Its course is almost directly south. Originating among the upper Silurian or gray cliff limestone, in its progress it cuts the out-cropping Devonian sandstone and slate, and finally reaches the Ohio at Portsmouth, in the midst of the conglomerate which makes the foundation of the Appalachian coal basin. Until it enters the last out-crop, its basin is comparatively level, in many parts flat; and this character of surface extends over more than five-sixths of it; the elevation of which is from nine hundred to one thousand feet above the level of the sea.

The larger part of the surface consists of dry and fertile lands, partly wood-land and partly prairie, but it includes several varieties, which deserve to be mentioned; *first*, small lakes or ponds of clear, cold water; *second*, wet or marshy prairies, generally the beds of filled-up ponds; *third*, extensive wooded swamps, which become nearly dry in autumn; *fourth*, sloughs, or 'slashes,' as they are called by the inhabitants, of small extent, overshadowed by water-maples and gigantic white elms, supporting a luxuriant growth of the *Rhus toxicodendron*, and generally drying up in summer. A specimen of the black soil from one of these sloughs, analyzed at my request by Doctor Raymond, gave the following results:

IN ONE HUNDRED GRAINS OF BLACK SOIL,

Organic extract, with a trace of nitrate of soda, - - -	2.5
Carbonate of lime, - - - - - - - -	5.
Phosphates of alumina and iron, - - - - - -	4.5
Decomposed organic matter, - - - - - - -	36.
Undecomposed " " - - - - - - - -	18.
Alumina, with a trace of iron and lime, - - - -	7.
Silica, - - - - - - - - - - -	26.5
Loss, - - - - - - - - -	.5
	100.0

The limited elm and maple swales or shallow ponds, one of which afforded the specimen of soil which was analyzed, constitute one of the special features of this basin. I have seen them in but one other locality, and that, although topographically remote, is geologically identical. I refer to the Louisville plain (*see p.* 247). That terrace, it will be recollected, is composed of the *debris* of black or Devonian slate, resting on gray limestone. Now, in tho upper part of the Scioto Basin we find the eminences capped with the same kind of slate, resting on the same variety of limestone; the strata at Louisville cropping out to the west from beneath the Illinois coal formation; those of the basin we are now examining from the south-east, from beneath the Appalachian coal formation. Disintegrated slate is, then, the *nidus* of these swales; a fact which enlarges our views of the relation between geology and medical topography.

Another feature of the upper or northern portions of this basin, as of the Muskingum (Section III), is an immense deposit of northern drift, by no means confined to the streams, and greatly obscuring the rocky strata.

The Scioto, and nearly all its tributaries, flow through wide valleys, but little depressed below the level of the country, until we come into the lower or southern part of the valley, where the bottoms are still wide, but the valleys are cut deep into the sandstone, slate, and conglomerate formations. Generally in the valleys there are two, and sometimes three terraces; the lowest of which may be called alluvial, is commonly wet, and frequently suffers inundation. The others are above high-water mark, consist chiefly of sand and pebbles, and may be regarded as diluvial. When the river, in the south, enters the hilly part of the basin, its bottom-lands continue of great width, and suffer under spring floods; but those of the smaller streams become much contracted. Some points in this portion of the basin, are among the highest in the State of Ohio, as, for example, Hillsborough, in Highland county, which has an altitude of eleven hundred and four feet above the level of the sea, and also the conical summits of the conglomerate hills on the eastern side of the river, in the neighborhood of Chillicothe, and thence to the Ohio River at Portsmouth.

As a general fact, it may be stated that every part of the Scioto Basin. from the beginning of its settlement, has been infested with autumnal fever, both intermittent and remittent, which, although mitigated in the long-cultivated portions, is by no means extinct. A brief notice of a few localities may serve for the whole.

II. Washington.—This inconsiderable village, the seat of justice of Fayette county, is situate near Paint Creek, a western tributary of the Scioto, at some distance from its junction with the river. The surface of the surrounding country is either level or slightly undulating; prairies and wood-land are intermingled; some of the former are wet and springy, while the latter are divisible into two varieties, open oak-lands with dry and thick soil, and compact diversified forest, abounding in occasional ponds and shallow swamps, which dry up in summer and autumn. The substratum is the upper Silurian or cliff limestone, from which the Devonian slate has been swept off or disintegrated. The rocky strata are generally buried up in clay or gravel. The streams, consisting of the upper branches of Paint Creek, from the general levelness of the country, have a most sluggish current; their low banks are badly defined, and subject to extensive inundations; while their beds are foul, and obstructed with decaying timber. The annual prevalence of autumnal fever, in such a locality, is what might be expected; but my object is something more than to make this known.

An Epidemic.—This village stands on the north-east side of Paint Creek. About the year 1820, a mill-dam was erected a short distance above the town, which caused the inundation, to the depth of a few feet, of about sixty acres of bottom-land. As the stream generally fell too low, by the first of June, to admit of grinding at the mill, it was the custom of the proprietors to open the flood-gates and let the water escape, after which the copious showers of that month commonly washed away the recent deposits, and thus the health of the village did not appear to suffer. In the year 1838, the owners did not let off the water until July, and no rains followed to wash away the silt. In a short time an offensive smell was wafted from this foul and drying surface into the village, which was to its leeward, and in the month of August the inhabitants began to sicken with remittent and intermittent fevers. In a population not exceeding four hundred, my informant, Doctor Henton, the principal physician, prescribed for nearly eighty, and the village lost eleven of its inhabitants. Those who lived on the streets nearest the pond suffered most. The people who resided in the vicinity, to the west or windward, did not suffer. No epidemic, so severe, had ever visited the village before. It did not cease with the autumn, but continued in the form of winter and spring fevers. In the two succeeding years, up to the time of my visit in 1840, the water had been drained off the first of June, and much of the drift-wood and filth cleared away; apparently, in consequence of which, the epidemic had not recurred.

III. Columbus, the seat of government of Ohio, stands on a broad terrace, which stretches eastwardly from the Scioto River. A narrow slip of lower bottom than that on which the city is built lies between its western side and the river. There are no hills near the city on the left-hand side of the river, but on the right, after crossing the broad low bottom, subject to partial inundation, on which the town of Franklinton stands, we arrive at a range of hills or bluffs about one hundred feet high. Near the upper part of Columbus, a large affluent, called the Whetstone, pours its waters into the Scioto, through its left bank. To the east of the city, at the distance of a few miles (without any intervening hills), flows Alum Creek, to join Walnut Creek, which afterward enters the river some distance down. From the lower part of the city, a canal, twelve miles long, passes down the river to join the Ohio and Erie Canal. Near the junction of these canals, the surface of the country is flat, wet, and extremely fertile, the consequence of which, as I learned from Doctor Gard, is the annual prevalence of severe and often malignant intermittent and remittent fevers.

To return to the city, it may be said, that although its suburbs and vicinity are in many places wet, and everywhere abundant in organic matter, the prevalence of autumnal fever has not been such as to prevent a rapid growth, which began in the year 1816, up to which time its site was a forest.

The latitude of Columbus is 39° 57′ N.; its elevation above the sea, seven hundred and sixty-two feet. The State of Ohio has made here four establishments of interest to the physician — a penitentiary, a lunatic asylum, a school for the deaf and dumb, and a school for the blind.

IV. Chillicothe.— The site of this town is a high alluvial or diluvial plain, on the west bank of the Scioto River, about fifty miles from its mouth. The valley here is wide, and presents, in the rear of the town, rounded or flatted hills, with an upper stratum of sandstone, and on the eastern side higher and more conical hills, capped with the overlying conglomerate. To the north, above the town, some portions of the plain are liable to inundation, and near the base of the adjacent hill, to the north-west of the town, there is an extensive pond, supplied with water from the high lands. On the opposite side of the river, above the town, the bottoms are wide, and considerable tracts are subject to overflows from the river; which, moreover, divides into two channels, and forms a low and wet but grassy island in sight of the town. To the west, the plain juts up against the base of the slate and sandstone hills. To the east, it declines toward the river, and presents a tract of low bottom, from which the rains drain off imperfectly, and over parts of which the river rises in every high freshet. This bottom extends down the river to the south, and is traversed by Paint Creek, a large tributary, which flows in from the west, through a wide valley, with low bottoms. At and around the junction of this stream with the Scioto, south south-east of the town, the bottoms generally are depressed, and, although (like the others which have been named) they are now under cultivation, the river-floods and the spring rains give them a wet surface; which, together with their extreme fertility, produces a rank annual vegetation. Finally, to the east, there is a mill-pond, at the distance of a mile and a half; and the Ohio and Erie Canal, with two or three locks, passes through the northern and eastern edge of the town. The redeeming circumstances in this otherwise unpromising topography, are the long range of hills directly to the south-west and west, or windward, of the town; while the extensive and prolific sources of autumnal fever lie in such directions, that the winds of August and September do not often blow from them to the town. Nevertheless, it is undeniable, that the inhabitants living along even the most populous streets, are liable to autumnal fever, while those of the suburbs, especially below the town, are much more affected by it.

Chillicothe, for many years the seat of government of Ohio, is one of the older towns of the state, having been commenced in the year 1796. From its early medical historian, Doctor Peachy Harrison,* we learn, that for the first five or six years, it suffered very little from fever; but in 1801 a violent epidemic arose, since which, it has been more or less invaded in the summer and autumn of every year. Its latitude is about 39° 20′ N.;—its altitude above the sea, six hundred and forty-five feet.

V. PORTSMOUTH. — On each side of the Scioto, as it approaches the Ohio, there is an extensive bottom. That below the mouth of the river, to the west, is low, extremely rich in soil, abounding in rank weeds, and overshadowed with trees — all of a kind which flourish best in wet situations. Every river-flood inundates this alluvial plain to such depth that it is uncultivable. The Ohio and Erie Canal, so often mentioned, passes through it to join the Ohio by the mouth of the Scioto.

The terrace above or east of the river is so high, that only some limited depressions are liable to submersion. On this plain stands the town of Portsmouth. The river-beach in front is free from topographical nuisances. On the opposite side of the river, the bottom is narrow and closely compressed by a range of steep and very lofty sandstone and conglomerate hills.

The latitude of Portsmouth is 38° 45′ N.; — the low-water elevation of the Ohio above the sea four hundred and sixty-eight feet; that of the terrace on which the town is built, about five hundred and forty.

As might be expected, the low bottom, to the west or windward of the Scioto River and of the town, is a prolific and permanent source of insalubrity; and fevers prevail more or less every autumn. According to Doctor Hempstead,† the experienced medical historian of this locality, the paludal influence is so great, that a large number of diseases assume more or less of a periodical type.

West of the Scioto, there is no tributary of the Ohio of sufficient size to demand a notice, until we arrive at the Little Miami, distant about one hundred and ten miles. In running that distance the Ohio bears south of west, as far as Maysville, Kentucky, then west north-west. The tract of country lying in this great bend is hilly near the river, but formed into a kind of table-land at a short distance back, with an argillaceous surface. I can say nothing special of its autumnal fevers.

* N. Y. Medical Repository, Vol. X, p. 6.

† Proceedings of the Medical Convention of Ohio, 1842.

SECTION VI.

THE MIAMI BASIN: CITY OF CINCINNATI.

I. General Description.— The 'Miami Valley' is the familiar appellation of the united basins of the Great and Little Miami Rivers; which comprehend the south-west angle of Ohio, and much of the south-east corner of Indiana. To the east, the upper tributaries of both these rivers intermingle with those of the Scioto; to the west, all the longer tributaries of the Great Miami arise on common ground with the sources of White River, the largest affluent of the Wabash, the chief river of Indiana; to the north, they interlock with the southern head streams of the Maumee of Lake Erie; and here it is that the basin of the lakes penetrates farthest into that of the Gulf of Mexico. All the southern portions of the Miami Basin are composed of the older or lower Silurian limestone — the blue shell — with a copious interlamination of marlaceous blue shale; the northern parts of the basin rest on the newer or upper Silurian limestone, but much of it is buried up in drift or diluvium, like that of the upper basins of the Muskingum and Scioto. The whole of this portion is either level or undulating; but on approaching the Ohio River in the lower basin, deep ravines give rise to rounded hills, which do not, however, rise above the general level. Both the Miamies, as they descend to the Ohio, present troughs or immediate valleys, which continue wide, and gradually deepen, down to the level of that river. Their descent from the water-shed between the Ohio and Lake Erie is so rapid, that the back-water of the Ohio is only felt ten or twelve miles from their mouths; while on the opposite side of that river it produces stagnation in Licking River to the distance of forty or fifty miles; and in the Kentucky, for seventy-five miles.

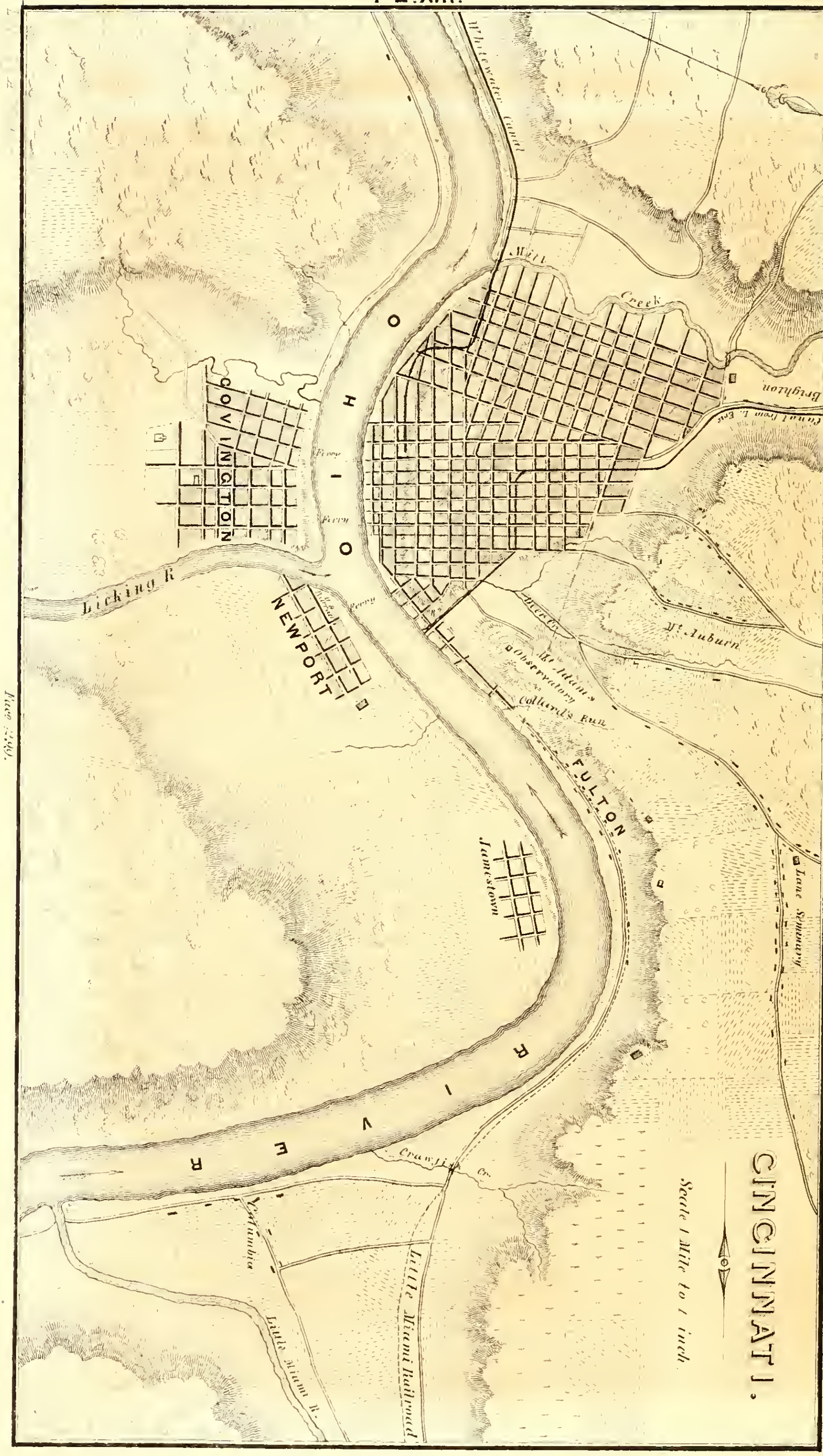
The immediate valleys of the Miamies present several terraces or bottoms, rising over each other, and composed, like those of the Ohio, of transported materials from the north. In the spring and early summer, many of the lower bottoms are frequently overflowed. As these streams descend an inclined plain, their currents are rapid, and they present but few stagnant pools, compared with the rivers of the opposite side of the Ohio, just referred to. The upper portions of this basin abound in wet or marsh prairies, wood-land swamps, and ponds, or small lakes of pure water. The southern portions offer but little of either, on the uplands; but in the wide valleys of both the Miamies, and along all their larger tributaries, every variety of wet surface was found in spring and early summer, when settlements were first made: by clearing, cultivation, and draining, however, a much dryer condition has been produced. At the same time, mill-ponds have been greatly multiplied, and two canals, one from Cincinnati to Dayton, and thence to Lake Erie, and the other from the former city, to Brookville and Cambridge, in the State of Indiana, have been excavated. In the month of June they are annually emptied of water, and the mud accumulated in their bottoms, is scraped out upon their banks. The canal to Dayton, on starting from Cincinnati, takes up the valley of Millcreek, and, at the distance of twenty-five miles, enters the valley of the Great Miami. Through the whole distance, it traverses a fertile valley, from one to three miles in width, abounding in diluvial terraces and low alluvial bottoms, to which the present diminutive stream bears, in the volume of its waters, no assignable proportion. This valley is, in fact, the obsolete bed of one of those vast river-currents, which once flowed from the north into the trough of the Ohio River. At that time, the stream which is now called the Great Miami, divided into two mouths, at Hamilton, twenty-five miles north of Cincinnati; and its eastern branch flowed through this valley, near the head of which, there are ponds, which resemble the crescent-lakes of the lower Mississippi, represented in *Pl. V.* A few miles north of Cincinnati, this prong of the extinct river, again divided, and sent off a branch to the east, which entered the Little Miami not far above its mouth: which river then was of great width and depth. This disparity between the present volumes of water and the broad valleys through which they flow, is a common characteristic of the rivers on the north side of the Ohio, from the Appalachian Mountains to the Mississippi; and, hence, the extent of bottom or interval-lands, in the region just indicated, is incomparably greater than in that south of the Ohio, which was never furrowed out by such currents.

The general level of the hill-summits of the Miami Basin is not the same throughout. Along the Ohio River it is from eight to nine hundred feet; at the sources of the Great Miami, from eight hundred and forty-two — the lowest depression at the St. Marys — up to fourteen hundred feet,* around Bellefontaine, through which the railroad from Cincinnati to Sandusky passes. This protuberance constitutes the highest land in the state of Ohio. As the valleys by which the Miamies reach the Ohio are troughs of excavation, the altitude of their bottoms increases regularly from the principal river, where they are about five hundred feet, up to the summits which have been indicated; the bounding hills regularly diminishing in elevation above the streams. As to position, the Miami Basin extends from latitude 39°, to about 40° 30′ N.

Personal observations in the Miami Basin, for forty-eight years, that is, since the twelfth year of its settlement, enable me to say, that it has at all times been subject to autumnal fever; which, along the streams, has been both intermittent and remittent, while on the intervening hills and table-lands, the latter type has generally prevailed.

From the earliest period down to the present time, these fevers have been of a simple or inflammatory character, though malignant or congestive cases have not been unknown. The progress of settlement and cultivation has diminished, but not put an end to their annual visitations. This effect is most perceptible in the towns, such, for example, as Hamilton, Dayton, or Springfield, which are at present less infested than in the early period of their settlement. The laborers, by whom the canals were excavated, suffered in autumn from fever; but, living as they did, they would probably

* Letters on Geology. By David Christy.


CINCINNATI.
Scale 1 Mile to 1 inch
OHIO RIVER
COVINGTON
NEWPORT
FULTON
Licking R.
Jamestown
Mt. Auburn
Lane Seminary
Mt. Adams Observatory
Collard's Run
Deer Cr.
Mill Creek
Whitewater Canal
Brighton
Canal from L. Erie
Ferry
Ferry
Ferry
Crawfish Cr.
Columbia
Little Miami R.
Little Miami Railroad

have suffered in the same degree, if not engaged in that employment. It does not appear, that the inhabitants of the regions through which the canals were dug were injured by the process, or by letting in the water when they were finished; nor have I been able to collect any reliable evidence, that the annual emptying and cleaning out, have been productive of fever; which should, perhaps, be ascribed to their receiving but little organic matter. The mud thrown out is, in fact, chiefly the *debris* of their earthy banks.

One of these canals seems, however, to have given origin to autumnal fever in the summer and autumn of the present year, 1848. I refer to the Whitewater Canal, which runs along the river bank, from North Bend to Cincinnati — fifteen miles. From a break in its banks the year before the water was drawn off, and from its bottom abounding in shallow pools left exposed to the sun, through the seasons just mentioned, autumnal fever became epidemic along its whole length (some cases assuming a malignant character), where it had hitherto, for many years, occurred but sporadically.

The Miami Basin — taken as a whole, the oldest-settled portion of the State of Ohio — embraces many flourishing and populous towns; but as their topography is much the same, being nearly all built on river terraces, I shall dismiss them with the general remark, that their suburbs and vicinities are much more infested with autumnal fever, especially its intermittent variety, than their interior and populous streets, and that even the former have felt the ameliorating influence of clearing and cultivation, to a very decided extent.

II. City of Cincinnati. — When, on the 26th of December, 1788, the third landing for the permanent settlement of Ohio was made, where Cincinnati now stands, there were already in the Interior Valley of North America (between New Orleans and Quebec) more than thirty towns. In sixty years, the encampment of twenty-six men, by the side of a beaver pond, beneath a dense forest of beech trees, has grown into a city, which has a more numerous stationary white population than any other within the Great Valley; and, in numbers, ranks as the fifth city of the United States. Such an unrivaled growth would, perhaps, justify an ample notice of its condition, even if the medical historian were not identified with it in feeling, interest, and early recollections.

A glance upon the map (*Pl. XIII*) will disclose, to the experienced eye, not, it is true, the social and political causes of this rapid development, but the favorable absence of many topographical conditions, the presence of which might have countervailed them.

The site of the city, on the left bank of the Ohio River, consists of two plains or bottoms, one near the river, comparatively narrow, and composed of argillaceous alluvion; the other in its rear, six or eight times as broad, diluvial, and made up, like the higher or second terraces generally, of pebbles, gravel, and sand, with a covering of loam and soil. The lower plain widens as it stretches down the river, and its back part, on the settlement of the town, was a narrow, shallow, and heavily-timbered pond or swamp, overflowed by ordinary spring floods of the river, which ascended upon it along the marshy rivulets by which that tract was partially drained into the Ohio, below the town. In 1793 the whole of the lower plain was submerged; and in 1832 and 1848 the inundation was repeated, upon every part which had not been raised, with materials washed by the rains, or hauled from the adjacent higher terrace. For many years after the settlement of the village, the drainage of both terraces was into the low grounds of this bottom, where it accumulated in part upon the surface, and partly in the numerous pits, formed by the manufacture of brick. From these foul accumulations, in summer and early autumn, a constant escape of gas through the superincumbent water could be perceived. The extent of this tract, lying to the west or windward of the village, was sufficient to generate a great many cases of autumnal fever, chiefly of the remittent type, not a few of which every year proved fatal.* Had its surface been but a few feet lower, so that it could not have been reclaimed, the nuisances in which it abounded must have exerted a retarding influence on the progress of the city. But for the last twenty years the work of transformation by draining, filling up, and building over, has been steadily advancing, and with it a corresponding improvement of autumnal health.

From the lower plain to the upper and older, the ascent is between fifty and sixty feet. With the growth of the town, the front margin of the latter, which was originally a bluff bank, has been graded to a gentle declivity, and the removed material used, as already intimated, to raise the back part of the lower bottom; so that the drainage of the city is now chiefly by the streets directly into the river.

The upper terrace, as was the case with the lower, slopes gently back from its southern or river margin, and, at the average distance of a mile, terminates against the base of the Mount Auburn range of blue Silurian limestone hills; whence, during rains, there descend upon it several torrents, which coalesce and flow nearly in the same direction with the river. To the east this terrace is terminated by the narrow valley of a hill-torrent, called Deer Creek. Up this valley, in early times, the back-water of the river, when in flood, ascended for half a mile; and on its recess left a deposit of silt, which, however, was to the summer-leeward of the town, and therefore never produced much effect on the health of the people. Beyond this ravine stands Mount Adams, between the base of which and the eastern margin of the city terrace the low ground has been raised above the highest river floods, a culvert has been formed for the creek, with streets extended across it, and the new surface built upon. The ravine, higher up, has a rocky bed and no bottom-lands.

The Western Canal, from Lake Erie, generally called the Miami Canal, traverses the back part of the upper terrace, from north-west to south-east,

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* Drake: Notices concerning Cincinnati, 1810.

and descends into the Ohio by a series of locks through this valley, but does not seem to have generated fever.

We must now turn to the western margin of the terraces. In stretching off in that direction down the river, both become wider and sink lower, until they are lost in the broad alluvial valley of Mill Creek, which stream, once a great river, joins the Ohio one mile and a half below the center of the city. Its banks are of mud, and portions of them are overflowed by river freshets. The work of elevation, by the transfer of gravel and pebbles from the upper terrace, is, however, going on with the rapid extension of the city in that direction; so that the time seems to be at hand when the whole tract will be redeemed from all but the extraordinary floods which happen at distant periods, and of which there have been but three since the first settlement of the city. From that date down to the present time, the inhabitants of this locality have been subject to autumnal fever, while those farther east remained exempt.

The Whitewater Canal, from Indiana, which is conducted up the river bank, crosses Mill Creek by an aqueduct, and traversing the lower terrace, terminates in a basin of stagnant water in the south-western part of the city, contributing, no doubt, to the prevalence of fever in that quarter.

The river shore, from the mouth of Deer Creek to the mouth of Mill Creek, a distance of two miles and a half, presents but few nuisances. At the former point the stream has thrown out a quantity of silt, which, in low water, is laid bare to a limited extent; from that spot to the other, the shore is free from natural sources of insalubrity, much of it being sloped and graveled down to low water. In front of the mouth of Mill Creek there is a deposit of silt, enveloping the trunks and limbs of trees, of which a considerable extent is exposed in summer and autumn, and, lying to the windward of the city, may be regarded as the most permanent nuisance around it. Below the *embouchure* of Mill Creek, for two miles, and above that of Deer Creek for four miles, there is no alluvial bottom, and the river presses against the base of the limestone hills.

We must now cross the Ohio, and speak of the towns of Newport and Covington, as promised when treating of the Licking River Basin. The mouth of that river is nearly opposite the center of Cincinnati. Above it stands the old but slow-growing town of Newport; below, the young and more vigorous town of Covington. The position of these towns is represented on *Pl. XIII.* The bottom on which the former stands, is ample; and, except a margin of its back part near Licking River, is elevated above the highest floods of the Ohio. Where the plain approaches the hills in its rear, there is some swaley ground, bearing semi-aquatic grasses, which becomes dry in autumn. The Newport bottom extends up the Ohio three miles, as a dry, elevated, and sloping plain, and has become the site of a new village, JAMESTOWN, opposite the village of Fulton. The Covington terrace, below the mouth of Licking, is still more elevated than that of Newport, and, with the exception of a ravine through its western margin, up which the waters of the Ohio ascend in high floods, is free from every insalubrious topographical condition. A range of dry hills rises boldly to its south-west, one of which almost touches the Ohio opposite the mouth of Mill Creek, receding immediately afterward, and affording a broad, elevated, and arid bottom, on which another village, supplementary to the city, has been commenced. The bottom-lands of Licking River above these towns, and directly south of them, are about a mile in width, but so elevated, that they are but partially overflowed by river-freshets, which leave behind them very few ponds or marshes. Finally: On the promontory above the mouth of Licking, the general government, since the year 1805, has had an arsenal and barracks; but the number of troops stationed there has generally been small, and no returns have been published in the army statistics.

The prevalence of autumnal fever in Newport and Covington has at all times been in harmony with their topography as here described. In the latter, the number of cases is smaller in proportion to the population than in the former; which is what its topographical condition demands. The cases which occur are chiefly on the border which extends up the valley of Licking. That valley lies to the windward of Newport, and exerts a prejudicial influence on the health of that portion of its people who live nearest to it; but they are never seriously invaded.

Let us now contemplate, as a whole, the locality we have been surveying in detail. *First:* As a general fact, where a tributary enters the Ohio, there is much low bottom; but here, two join it, on opposite sides, and the extent of drowned land is very little. I have elsewhere intimated that Mill Creek, during the diluvial period, was a great river; and then it was, that an immense quantity of drift, in the form of sand, gravel, pebbles, and bowlders, was heaped up in this locality to such a hight that nearly all the terraces are above the ordinary freshets of the Ohio. *Second:* The area of these terraces, including both sides of the river, is about six square miles; and their extent, taken in connection with their elevation above the river, gives this locality an advantage over every other, from the sources to the mouth of the river. *Third:* As a consequence of this topography, there is no other spot on the banks of the Ohio, where so great a number of persons could reside with as little exposure to the causes of intermittent and remittent fever. *Fourth:* From observations continued through forty-eight years, I am enabled to say, that while, in early times, autumnal fever, occurring every year, was seldom, except in some very limited spots, a violent and frequent disease, it has regularly diminished; and that parts once infested have become exempt. So true is this of the central portions of the city, in latter years, that when a case of intermittent fever happens there, it is generally found that the patient had sojourned in the country. Of remittent fever, so much cannot be said, as occasional cases still appear on streets which are entirely exempt from the other variety. *Fifth:* The estimated population, within a circle having a radius of a mile and a half, is about one hundred and ten thousand; and the extraordinary growth, which has assembled such a number in so short a time, must undoubtedly be ascribed, in part, to the slight prevalence of autumnal fever; by which we are instructed, that medical topography has an intimate connection with the progress of population and civil improvement.

Cincinnati has extended (chiefly by a single street) nearly four miles up the Ohio, with the river close on one side and the hills as close on the other; the bank rising above high water This extension comprehends the villages of Fulton, Lewistown, and Pendleton. Beyond the last, to the mouth of the Little Miami River, two miles further up, there is a broad, alluvial plain, on which once stood the village of Columbia, the second settlement in the State of Ohio, made November 18th, 1788. Much of this bottom, especially that nearest the Miami, is subject to inundation in the spring of the year, and the inhabitants, chiefly agriculturalists, are subject to autumnal fever; which, however, is much less prevalent and violent than I saw it in 1803, and for many years afterward, when the locality was *in transitu* from dense woods to cultivated fields.

Up the valley of Mill Creek, which is equal in width to that of the Ohio (although in summer there is scarcely the feeblest current of water), autumnal fever is an annual endemio-epidemic. This valley is not without second, and even third, bottoms or terraces, which are elevated and dry; but it has also broad and low alluvions, on which the overflows of the stream and the spring rains leave sloughs filled with the decaying vegetation of its deep and fertile soil. To these surfaces we should ascribe the fever, which, limited to them in its origin, extends far beyond them in its spread; as it frequently reaches, not only those who reside on the older terraces, but, also, the inhabitants of the neighboring bluffs. The malignant intermittents of the south are not, however, often met with in this locality, nor ever have been; and the chief mortality is from the remittent type, in its progress becoming typhous.

The hill-lands around Cincinnati are, in all directions, of the same hight and character. In some places there are gently undulating table-lands; but in general the country is rolling, and presents a countless number of knobs or tuberosities, covered with rich soil, resting on a clay or loam bed, embellished with numerous country seats. Permanent springs are scarce, and much of the well-water is of an inferior quality. Ponds, swales, and swamps are, of course, unknown; yet autumnal remitting fever, tending to a continued type, occurs more or less every year, and sometimes proves fatal.

For many years after the first settlement of Cincinnati, the people supplied themselves with water from wells, and, also, from the river, as is still the case in Newport and Covington. But to these methods succeeded the present hydraulic system. The water is thrown by a forcing pump into reservoirs, exposed to the sun and rains, whence it is distributed, through iron and lead pipes, over the city. It often comes to the consumers turbid. The silt which it deposits in the reservoirs, a portion of which, remaining in suspension, is swallowed with the water, no doubt varies considerably in its composition. A single analysis, of a specimen thrown out of the reservoir in the spring of the year, was made, at my request, by Doctor Raymond, and gave the following results in one hundred parts:

Alumina,	49.84
Silex,	38.30
Carbonate of lime,	2.00
Do. Iron,	1.15
Phosphates of alumina and iron,	0.52
Carbonate of magnesia, a trace,	0.00
Vegetable mold (humus),	3.50
Other organic matter,	4.69
	100.00

In general, during every flood, the water when distributed is turbid.

For a long time after the settlement of Cincinnati, its only fuel was wood; but this, to a great extent, has been superseded by bituminous coal, from the Appalachian Basin. At present, the amount consumed is greater than in any other locality in the Interior Valley, save Pittsburgh. This results, not merely from the great number of inhabitants, but also from the multiplication of their manufacturing establishments; some of which will come under review when referring to the causes of other diseases than autumnal fever. From the better ventilation of this locality, its atmosphere is, however, much less laden with the fumes of burning coal, than that of Pittsburgh. The natural facilities for this ventilation may be seen by referring to the map.

Cincinnati stands in Lat. 39° 6′ N., and Long. 84° 29′ 30″ W. The elevation of the surface of the river, at low water, above the level of the sea, is four hundred and thirty-one feet; that of the lower plain about four hundred and ninety; that of the upper, five hundred and forty-three; that of the surrounding hills, on an average, not far from eight hundred and fifty feet.

The population of the city presents many varieties of physiology. The original settlers were from various states of the Union; and the armies of Harmar, St. Clair, and Wayne, during the Indian wars, left behind them a still greater variety of persons. The subsequent immigration, although largely from the Middle and Northern Atlantic States, has been, in part, from the more Southern. In latter years it has been composed, still more than from either, of Europeans. The most numerous of these are Germans, next Irish, then English, Welsh, and Scotch. Very few French, Italians, or Spaniards have sought it out. Lastly, its African population, chiefly emancipated slaves and their offspring, from Kentucky and Virginia, is large; and although intermarriages with the whites are unknown, the streets present as many mulatto, griffe, and quadroon complexions, as those of New Orleans. Thus the varieties of national physiology are very great.

SECTION VII.

NORTHERN BANKS AND HILLS OF THE OHIO RIVER, FROM THE GREAT MIAMI TO THE WABASH.

I. General Characteristics.—It is a remarkable feature in the tributary-hydrography of the middle section of the Ohio, on its northern side, that from the Great Miami to the Wabash, a distance of three hundred and seventy-five miles, there is not a single affluent which deserves the title of river,—not one that is more than a wet-weather hill-torrent, insufficient even for mill purposes, except in rainy seasons. In fact, at distances, varying from ten to thirty miles, back from the Ohio, the streams flow off to the north, and have their confluence in the East Fork of White River, which, uniting with the West Fork, pours its waters into the Wabash.

Here, then, is a long, narrow, serpentine zone, deeply cut by rivulets, which, descending to the south, enter the Ohio through its broad bottoms, or by other streams which flow to the north, in excavations which are less profound. Such a tract cannot abound in swamps or ponds, and the water-courses present but few wide alluvial bottoms. As a general fact, they sink to the level of the Ohio before reaching it; and, therefore, near their mouths, become, in all its floods, receptacles of back-water, which on receding, leaves deposits of mud and drift-wood, which the subsequent rains generally wash out into the river. When, however, there is a June flood in the Ohio, the silt is apt to remain through the subsequent dry season, and prove a source of insalubrity. Hence, those who live near these foul estuaries, which mingle their influence with that of the river-bottoms, experience intermittent and remittent fevers, notwithstanding they are in the midst of a hilly country. In traveling on this zone from its upper to its lower extremity, we start upon the blue shell or old Silurian limestone; then meet, resting on it, with the upper or cliff Silurian; then with the Devonian limestone, supporting the black slate, on which rests the fine-grained sandstone of the same group; after which, we meet with the carboniferous limestone, and the higher strata within the Illinois coal basin. All these formations crop out to the east or south-east, from beneath that basin. Of course the mineralogical character of the surface, composed as it is of the *debris* of these different formations, intermingled with forest and herbaceous remains, varies according to the mineral constitution of the rocks; and a similar remark is applicable to the water of the springs and wells. The whole tract is wooded, the trees varying in their species with the varieties of soil. The mean elevation of the zone may be taken at eight hundred feet, but the highest swells attain the altitude of one thousand feet. We must now say something of the most important localities.

II. Lawrenceburg stands a mile below the mouth of the Great Miami, in the State of Indiana; the dividing line between that state and Ohio, being the meridian of the mouth of that river. Its site is a bottom, so low that all parts not artificially raised, are subject to annual inundation. Above the town, to its east and north-east, are the wide, low, and annually inundated bottoms, on each side of the estuary of the Miami, well known to generate autumnal fever; but as they lie to the leeward of the town, their pernicious influence, in summer and autumn, is much less than it would otherwise be. Yet, doubtless, they contribute something to that prevalence of intermittent and remittent fever which is partly to be ascribed to the inundation of the greater part of the plain, on the front of which the town is erected, and partly to a valley-stream in its rear, called Tanner's Creek, up which the back-water in river-floods makes it way almost round the town. The main street, since it was raised, is four hundred and seventy-three feet above the sea — the hills at the sources of Tanner's Creek ten hundred and thirteen feet.* In the early period of the settlement of Lawrenceburg, these fevers were extremely prevalent; but at present are so mitigated in frequency and violence, as to show very conclusively the influence of cultivation and town-construction, in destroying the topographical condition on which they depend. Within a few years, a branch of the Whitewater Canal has been brought through the town, but of its influence on autumnal health I cannot speak.

Passing by Aurora, Rising Sun, and some other villages (for all cannot be noticed), we must devote a page to a larger and more important town than either.

III. Madison. — This town, one of the oldest and most considerable in the State of Indiana, is situated on a diluvial and dry second bottom of the Ohio River, but has, in front of its lower half, a narrow strip of alluvion which is subject to occasional inundation. The upper terrace is elevated about four hundred and seventy-five feet above the sea. Its breadth is not very great, for an amphitheater of Silurian limestone hills, rising four hundred feet higher, closely surrounds it. The back part of the terrace declines a little, and is somewhat cut up by ravines, which run into a common trough called Crooked Creek, in which the torrents from the adjoining hills sometimes congregate so as to occasion a considerable inundation. This stream enters the Ohio two miles below the town, behind which it conducts the back-water of the river in every great freshet. The banks, however, are high, and, on the whole, the plain is not infested with any form of drowned lands; the shore, in front of the town, is free from nuisances; and the opposite hills of Kentucky approach close to the river, whose course to the south-west, on leaving the town, favors ventilation by the summer winds, which, in reaching it, do not pass over any paludal surface. Such a topography must admit of a favorable report, as to autumnal fever; which, in fact, prevails here but to a limited degree.

IV. Jeffersonville. — The position of this town may be seen on *Pl. XI, Ch.* IX, *Sect.* VII. It stands about a mile above the Falls of the Ohio, on a terrace, the south or river side of which is forty feet above low water, and about four hundred and twenty above the sea. This terrace, like most others along the Ohio, declines from near the river, and is liable to inundations, so that in high floods the town becomes insulated. Both above and below it

* Indiana Engineers' Reports.

there are small streams entering the Ohio, which are the channels by which these overflows are effected. To the north and north-east, near the town, there are ponds skirted with marsh, one of which has been lately drained. The surface, like that of the plain on which Louisville stands, on the opposite side of the river, is argillaceous, and retains the water which rains or flows upon it. It will be observed that all the insalubrious surface lies to the summer-leeward of the town; but the flats and stagnant waters near the mouth of Bear-grass Creek, on the opposite side of the Ohio, are directly to the windward of this town, with only the river intervening. Jeffersonville is also to the leeward of the Falls, and exposed therefore to any insalubrious gases which may be liberated by the agitation of the waters. Two miles north of the town, a water-shed, between the Ohio River and Silver Creek, commences and runs to Charleston, thirteen miles north. At its commencement this terrace is sixty feet above the level of the town, and its rise, afterward, is about ten feet per mile. Doctor Stewart, to whom I am indebted for several of the facts in this article, informs me that autumnal intermittents and remittents are decidedly prevalent in Jeffersonville and its vicinity.

The Penitentiary of the State of Indiana stands in the western part of Jeffersonville. Doctor Collum, its physician, informs me that the convicts are every year invaded by autumnal fever, but in a degree rather less than the inhabitants of the town.

V. New Albany. — The position of this town is below the Falls, nearly opposite Portland (*Pl. XI*). Silver Creek enters the river between New Albany and Jeffersonville, which are about six miles apart. Of this stream, Doctor Clapp (by whom I have been favored with facts for this description) says, "it presents no ponds or marshes, within ten miles of New Albany, except mill-ponds, and they cause but little overflow of the surface." As to the town-site, a narrow slip near the river, not very much built upon, it has been entirely overflowed but twice in thirty years. The upper terrace is fifteen feet above the highest freshets, and four hundred and twenty-six above the sea. Immediately to its west is a small stream called Falling Run, up which the back-water of the river ascends a short distance; and about once in four or five years overflows a few acres. The bed of this stream is rocky, and its descent rapid. It flows at the base of the bold rampart called Silver Creek hills, which rises to an altitude of nine hundred feet over the sea, and four hundred and eighty above the terrace on which the town is built. This terrace consists of a bed of alluvion, thirty feet deep, resting on black or Devonian slate, which emerges from underneath the hills.

Of all the towns around the Falls, New Albany is the least exposed to the topographical causes of autumnal fever; and from the best data I have been able to collect, it suffers least. From 1817 to 1822, the first five years of Doctor Clapp's residence in it, those fevers prevailed extensively, but have ever since been diminishing.

VI. The Black-slate Valley-Plain. — A description of that portion of this plain which lies south of the Ohio River, was given in *Sect.* VII of the last Chapter, *p.* 246. Its extension to the north side of the Falls has been announced, in speaking of the substrata on which the alluvial or diluvial terraces of New Albany and Jeffersonville rest. It remains to say, that this depression extends northwardly quite into the interior of Indiana. For twenty-three or twenty-four miles, it preserves a width corresponding with that from the mouth of Salt River to the Falls. The hills then approach so near to each other, that the plain becomes an isthmus, and has received the name of Collins' Gap. It afterward expands; but to trace it farther would carry us too far beyond the limits of this Section. The approximate hills have an altitude, on the eastern side, of one hundred and seventy feet; on the western, of five hundred feet. The former are composed of the upper Silurian limestone, which has emerged from beneath the black slate; the latter of the sandstone which, farther west, overlays that formation. The disintegration of the slate, I may repeat, has produced this remarkable valley; the surface of which is nearly five hundred feet below the general level of the country. Its principal stream, on the north side of the Ohio, is Silver Creek. When the French traveler, Volney,* visited the Falls, in 1776, his attention was strongly turned to this depression, which, he conjectured, was the bed of a drained lake; a theory which is sustained by the undulating deposits, and, what Doctor McMurtrie† calls 'planispherical accumulations' of sand, which in various places rest on the argillaceous *debris* of the slate formation; a bottom which is almost water-tight, and has, consequently, given origin to the ponds and swamps which have rendered the whole tract unhealthy, in autumn, from the earliest period of its settlement. When the surface shall be completely drained and cultivated, the health of the inhabitants will undergo a great amelioration.

VI. EVANSVILLE, the commercial metropolis of south-west Indiana, stands a little below the thirty-eighth degree of north latitude, not far above the mouth of the Wabash River, and almost beyond the southern extremity of the hill-zone described in *No. I*, of this Section. I am indebted to Doctor Walker for the following account:

"The plain on which the town is built has an elevation of about three hundred and seventy-two feet above the sea, and ten or twelve over the highest floods of the Ohio. It is situated on the extreme convexity of a short bend made by the Ohio, which, after having flowed many miles to the north-west, turns suddenly and sharply to the south-west, and then to the south-east, whence, making a *detour* round to the west, north-west, and even north, it resumes its general course and flows off to the west. A sluggish bayou, beginning a short distance below the town, constitutes the chord of this great segment, or rather, completes a rude circle, which incloses fifteen or sixteen square miles of low bottom, fertile, subject to inundation, and lying to the south-west or summer-windward of the town. The bayou itself is foul, and has low grounds on both its sides. As the river approaches the town it

* View of the Soil and Climate of the United States: 1804, Philad.

† Sketches of Louisville. By H. McMurtrie, 1819.

divides into two channels, inclosing a long depressed island. The channel, which lies on the same side of the river with the town, and which reunites with the other but a short distance above it, is too shallow and obstructed for low-water navigation, and becomes foul in summer. Opposite the town, on the Kentucky side, there is an extensive bottom, which is liable to frequent inundations. The river-bottoms, commencing a mile below and half a mile above the town, are liable to submersions every four or five years, and are not destitute of ponds and sloughs. The terrace on which the town is built, stretches off to the north for many miles; a sufficient evidence that, in reaching this locality, we have nearly escaped from the zone of hill-country described in *No. I*, of this Section. A mill-stream, called Pigeon Creek, traverses this valley, passes near the rear of the town, and joins the Ohio a short distance below. Its banks are generally so high, that neither its own floods nor the back-waters of the Ohio overflow them to much extent.

The surrounding uplands rise from one to two hundred feet above the town-site, and present many tracts of table-land, abounding in swales and marshes.

This locality, both in town and country, but much more in the latter than the former, is subject to autumnal fevers, which often assume a malignant and fatal character. Many topical affections, moreover, such as neuralgias, assume a periodical character, and afford additional evidence of autumnal insalubrity.

With these notices we dismiss the river-zone, and travel into the interior. The region which must first receive attention, lies in the rear of that which has been described, and is comprehended in a small hydrographical basin. I shall treat it in the briefest manner.

SECTION VIII.

BASIN OF WHITE RIVER.

I. General Hydrography.— White River is the largest tributary, and almost a coequal, of the Wabash, which it joins about one hundred and ten miles from the junction of the latter (following its meanders) with the Ohio. On the north it is surrounded by the Wabash; on the east its sources mingle with those of the tributaries of the Great Miami; on the south, it receives the water of streams which originate on the northern slopes of the hill-zone which has just been described. White River is composed of two great branches, called the East and West Forks, the former of which flows nearly parallel with the Ohio, while the latter pursues a more southerly course, until they unite not many miles above the junction of their common trunk with the Wabash. Nearly a third part of the State of Indiana — its southern and south-eastern — is comprehended in this basin, the eastern portion of which rests on Silurian limestone, while the western lies within the great Illinois coal formation. Thus, its surface-rock is, in some parts, calcareous, in others, arenaceous, in others, schistose or argillaceous.

II. THE EAST FORK.—That division of the basin which is drained by the East Fork, is, in reference to its surface, a continuation of the lower or southern part of the Miami Basin; that is, it presents rounded wooded hills, not formed by elevation above the general surface of the country, but by valleys and ravines of excavation; some of which have bottom-lands of considerable width, but, on the whole, narrow alluvions, more like those on the south than the north side of the Ohio River. The body and basis of these hills is the limestone already mentioned. In passing westwardly we leave this limestone, not to meet with it again in the Ohio Basin, and come to the Devonian slate, which stretches, northwardly from the Falls of Ohio, in a belt of more level land, with a more pondy and swampy surface; to this succeeds — still going to the west — the rugged eastern margin of the coal formation, which, however, becomes more flat after we have passed the outcrop of sandstone which underlies the coal measures, and their associate shales, sandstones, and carboniferous limestones.

Every part of the region drained by the East Fork of White River, is subject to autumnal fever, which is more frequent and severe in the neighborhood of the river and its larger tributaries, than upon the uplands.

III. THE WEST FORK — more correctly the north — is a longer stream than the East, running nearly south south-west, through two degrees of latitude, but not draining a greater surface. The region from which it flows is more level than the last, embraces many prairies, both wet and dry, and presents along its streams much wide bottom-lands, with more of northern drift or transported materials on its surface. Thus, it is a continuation of the upper part of the Miami Basin. Its autumnal fevers are essentially the same as those of the East Fork.

IV. INDIANAPOLIS, the capital of the State of Indiana, stands on the left or east bank of the West Fork of White River, in N. Lat. 39° 55′, and W. Long. 86° 5′. The plain which constitutes its site is slightly undulating, with an average elevation of twenty feet above low-water mark, and about seven hundred above the level of the sea.* The principal part of the town is three quarters of a mile from the river. At a short distance above and to the north of the town, Fall Creek enters the river, which it reaches from the north-east. A smaller stream passes through the suburbs of the town, on the east and south sides, to join the river below. In summer and autumn this stream nearly dries up. Immediately north, there was formerly a pond, which discharged its superfluous waters across the town-plat; but a ditch has been made to drain it into Fall Creek. East of the town, at the distance of a mile, is the margin of a slightly rolling tract of argillaceous ground, covered with beech timber. To the north, the country is a little broken; but we have there the wide alluvial bottoms of White River and Fall Creek. West of the river, the bottom is a mile in width, and so low as

* Indiana Engineers' Reports.

to be overflowed in all high freshets. At the foot of the bluffs which terminate this bottom, there is a swale, or pondy belt, from ten to forty rods wide, overshadowed with trees and rank grass, or rendered foul with driftwood and other organic matters, thrown into it by the river floods. Its length is about two miles. Beyond this, to the west and north-west, for several miles, there is a dry, old terrace of sand, gravel, and other northern drift, bounded by Eagle Creek. On one of the undulations of this plain, stands the Lunatic Asylum of Indiana.* On the terrace east of the river, between it and the town, there is a canal, designed merely for hydraulic purposes, with a lock through which the water is restored to the river. Every summer it becomes choked up with a luxuriant aquatic vegetation, which is destroyed by letting out the water in July or August.

Doctor S. G. Mitchell† informs me that, on digging wells in the town, they first pass through four or five feet of soil and loam, then through fifteen or twenty feet of gravel, and afterward continue in white sand, as low down as perforations had been made. The same early medical historian of Indianapolis tells us, that the settlement of the town was commenced in 1820, when the plain was heavily timbered with various kinds of trees. In the spring of 1821, these were extensively cut down, and immigrants crowded upon the spot, until, by midsummer, they numbered about six hundred. They were miserably lodged in open cabins, shanties, and even tents; and subsisted largely on fish and game, with very little salt. July and August were unusually hot and wet. Every thing molded. The luxuriant foliage of the fallen trees and trodden-down annual plants, underwent a rapid decomposition. Exhalations offensive to the smell arose. Many domestic animals died, and, in the latter part of July, intermittent and remittent fevers appeared. They commenced near the river, and extended eastwardly through the new village, assuming a malignant character. Before the epidemic closed in October, nearly every person had been more or less indisposed, and seventy-two, or about an eighth part of the population, had died. Many of the most malignant or algid cases commenced as simple intermittents. Since that time, Indianapolis has not experienced a severe visitation; but its vicinity, especially to the north, remains, as its medical topography would lead us to expect, subject to annual invasions.

SECTION IX.

BASIN OF THE WABASH.

I. General Survey.— Although White River is a branch of the Wabash, its size and slight connection with that river, made it convenient to describe it under a separate head. The basin of the Wabash above the mouth of its great affluent, is long, narrow, and curved round from south-

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† Doctor John Evans. MS. *penes me.*

‡ Western Journal (Cincinnati), Vol. II, p. 443.

west to north-east. The mouth of the Wabash is found in N. Lat. 37° 47′, and W. Lon. 87° 45′; its most northern sources in Lat. 41° 15′, and its most eastern in Lon. 84° 30′. Originating in the western part of the State of Ohio, it traverses Indiana diagonally, and joins the Ohio River between that state and Illinois, not far below Evansville. Its upper waters originate in ponds or small lakes, and extensive marsh-prairies, on the summit-level between the Ohio Basin, and the basins of Lakes Michigan and Erie. Eminently an alluvial river, it everywhere has wide bottom-lands, many of which are subject to spring and early summer inundations, leaving behind them ponds, bayous, marshes, and swales, abounding in drift-wood, and other foul deposits. The fertility of these bottoms is great, and their vegetation luxuriant. All the upper portions of the Wabash Basin are overspread with extensive terraces or plains of clay, sand, gravel, pebbles, and other transported materials from the north, which bury up the rocky strata.* In the lower or southern portions of the valley, which are moderately broken, the amount of drift is much less, though it is abundant in the wide trough of the Wabash. It need scarcely be added, that such a region as has been thus comprehensively sketched, having an altitude not exceeding seven or eight hundred feet for its summits, while the bottom-lands of its streams are considerably lower, is liable to autumnal fever. That disease, in fact, prevails in every portion of it. But I must not dismiss it without giving an account of some of its more important localities.

II. Lafayette.—I have received from Doctor Deming the materials for a descriptive notice of this locality. The town stands on the left-hand bank of an eastern bend of the Wabash, in Lat. 40° 18′, at a hight of five hundred and thirty-eight feet above the level of the sea, and thirty-five feet above low water; an elevation which protects it from inundation. The upper strata of this terrace consist of sand and gravel, resting on a stratum of hard blue clay, in some places fifteen feet thick, which has to be passed through to obtain good well-water. Below this deposit, and in the hills, there are strata of sub-carboniferous limestone. The surface of the terrace is sufficiently undulating to favor draining. In the southern part of the town-plat there are a number of small streams, fed by springs, and there were formerly several acres of boggy marsh, which have been drained and put under cultivation. With the exception of this spot, there were no swamps or ponds near the town, on the east side of the river. In receding from the river to the east, an old or second bottom is encountered, the bluff margin of which has been sloped so as to present a gradual rise. The hill-land rises on the south side of the town to the hight of eighty feet—on the east, to one hundred and seventy feet—on the north-east, to one hundred and fifty. This semi-circle of highland is covered with timber, beyond which, eastwardly, lies the Wild-cat Prairie; portions of which were swampy, but have been reclaimed, with a consequent great amelioration of autumnal health. Opposite the town, on the western side of the river, a low bottom, commen-

* Doctor Owen's Second Geological Report.

eing a mile above, extends several miles below. It is annually inundated, sometimes to the depth of fourteen feet, and Doctor Deming has noticed, that its occasional summer-inundations are far more productive of fever than those of spring. The width of this bottom varies from a quarter of a mile to a mile. Lying to the summer-windward, this bottom, with the wet and swaley tract on the south side of the town, is no doubt the principal cause of the decided prevalence of autumnal fever, which annually occurs at this place. According to Doctor Deming, a large proportion of its diseases are intermittent and remittent fevers; many cases of the former, called by the people, 'sinking chills,' are decidedly malignant. So great, indeed, is the paludal influence, that almost all forms of disease, especially pneumonia, dysentery, and epidemic erysipelas, manifest its effects.

III. Terre Haute.—I have been favored by Doctor Read and Doctor Cloppinger, with facts for an account of this locality. The latitude of Terre Haute is about 39° 24′ N. Its elevation above the level of the sea, is four hundred and eighty-three feet*—above high-water mark of the Wabash, twenty-five feet. At the distance of three miles east from the river, there is another terrace about fifty feet higher. The town stands on the left or eastern side of the river, and occupies a portion of the western margin of the plain just mentioned, which is known as the Fort Harrison Prairie. This terrace, which, from its elevation, suggested the name by which the town is known, extends several miles up and down the river. It belongs to the diluvial epoch, and rests upon the coal measures. According to Doctor Read, in sinking wells into it, they pass through soil, and then white sand, with occasional layers of gravel, to the average depth of fifty-five feet (which is beneath low-water mark of the Wabash), when abundance of clear, cold, hard water is found, in a broad sheet or stream, making its way through the sand to the south-west, in the general course of the river. According to the same authority, there is, at the distance of half a mile east of the town, a depression of the terrace, to the extent of several thousand acres. Its length is parallel to the river, and it formerly received water from the higher ground, during rains, and was left with a swaley surface. That which flowed into it was, however, at length turned to the river, and the whole reclaimed and cultivated, with a favorable influence on the health of the inhabitants. Doctor Cloppinger did not observe that this swampy tract exerted any injurious effect on the health of the town, which lies to its west or windward; but the people who reside north of it suffered severely. On the opposite or western side of the river, there is a low, wide, heavily-timbered, alluvial bottom; which is, every spring and summer, deeply inundated, giving to the river in high floods the width of a mile. These floods leave the surface wet and foul; and in the middle of the bottom, half a mile west of the river, there is a permanent swamp of about twenty acres, between which and the town, there stands, however, a thick wood, which is supposed to exert a protecting influence.

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* Indiana Eng. Rep.

Both the gentlemen whom I have quoted, testify to the great prevalence of autumnal fever in this locality, where all the varieties, from the most simple up to the most malignant, are met with. In summer and autumn *all* diseases, according to Doctor Reed, tend to periodicity, and, in winter, pneumonia is so greatly modified by the paludal influence, that bloodletting is sometimes followed by death. Both these physicians, moreover, testify to the fact, that persons living near the margins, and almost on the level of the paludal tracts, are less subject to autumnal fever than those who reside at the distance of a half a mile or a mile, and at a higher elevation. In support of this statement, Doctor Cloppinger has made a number of specifications, which I have not space to transcribe, and concludes by informing me, that Doctor Patrick, an old and intelligent physician, long resident at Terre Haute, has observed all that is here recorded.

IV. Vincennes. — The site of this town, an old French village, settled more than a century since, is a beautiful diluvial prairie, from one to two miles in width, extending six miles along the Wabash River, on its left or eastern side. Most of the plain is sandy. The spot on which the town is built is not subject to inundations, but immediately below, and for three miles down, the bottom, before it was protected by a levee, was liable to submersion. About a mile and a half east of the town, there were several ponds and marshes, which, however, have been drained into the river, five miles below. Beyond these ponds there are bluffs, followed by clayey table-land. On the west, or right-hand side of the river, there is a belt of low timbered bottom-land, a mile in width, succeded by a prairie six miles wide, and of much greater length up and down the river, which, in high floods, is more or less subject to inundations, that leave ponds and marshes behind them. Such is the broad valley of the Wabash at this point. The elevation of its high or diluvial bottom-lands is about four hundred and fifty feet above the sea. The latitude of the town is 38° 43′ N., its longitude 87° 25′ W. Its population is two thousand five hundred, one-third of whom are descendants of the original French settlers.

The inhabitants of the prairie on the west side of the river, are subject, in a decided degree, to remittent and intermittent fevers; those on the eastern side are affected rather less, as to the number of cases, but more severely in degree. In latter years, malignant cases, late in autumn, have not been uncommon.*

V. New Harmony. — This is the settlement made by Mr. Robert Owen, of Scotland, in the year 1824. Its latitude is 38° 11′ N., its longitude 87° 35′ W. It stands on the left or south-eastern bank of the Wabash river, near a quarter of a mile from its margin, and about half a mile from a higher terrace in its rear. "The bottom on which the town is built," says Doctor Murphy, "is considerably more elevated than the slip between it and the river. The whole bottom, from the river to the highest terrace, is about a mile wide, increases gradually in width, as we ascend the river, and is under

* Doctor Joseph Sommes. MS. *penes me.*

cultivation. The level of the town site is about six feet above the highest floods of the river, and near four hundred feet above the Gulf of Mexico. The soil consists of rich vegetable mold, with a liberal admixture of sand, in consequence of which it dries rapidly after rain. The only standing water near the town is a brick-pond, to its south, which is sixty yards in diameter, and nearly dries up in summer. The water used by the inhabitants is from wells, which receive it by percolation from the Wabash, and, therefore, it is soft. To the north-west of the town is the river, the width of which is nearly a quarter of a mile. Half a mile below the center of the town the Harmony cut-off issues from the river, to join it three miles below; by which, from the circuitous course of the river, an alluvial island, fifteen miles in circumference, is formed to the west of the town. The whole of this surface is overflowed by river freshets, and ponds and sluices are left behind, but none of them lie near the town. It is covered by a dense forest, with luxuriant herbaceous vegetation, and none of it is under cultivation. Opposite the town is Fox Island, on the western side of which a portion of the Wabash flows, whenever it rises to a mean hight. This island is covered with forest trees and a cane-brake, and presents ponds and bayous, none of which, however, are near the town. It only remains to add, that to the south of the town there is a range of hills, and that the terrace on which the town is built stretches off some distance to the east, and is under high cultivation."

It is, I suppose, generally known, that in prosecuting his great experiment on the community-system, Mr. Owen assembled around him, on this spot, a number of distinguished *savans*, who knew much more of the physical than of the moral world. Both the cultivators of science and of the soil were long since dispersed; and a common American town, with eight hundred inhabitants, now occupies ground consecrated to the new social system. They are subject to the fevers of autumn, which often display a malignant character, like those of the towns higher up the river.

VI. Valley of the Wabash below New Harmony.—From New Harmony to the junction of the Wabash with the Ohio River, the distance is fifty-five miles. According to Doctor Murphy, the valley is in general from three to five miles wide; and there are but few spots in the whole distance which are not overflowed by the freshets of the river, to a depth varying from three to ten feet, until we approach the Ohio, when, from the back-water of that river, the inundation is often much deeper. These overflows often take place in summer, but do not seem to be the cause of insalubrity; on the contrary, dry and hot summers are the most unhealthy. On the other hand, Doctor Murphy has observed, that persons living off the river-bottoms and bluffs, on the uplands, are more sickly in wet summers than dry. In comparing the inhabitants in and near the valley with those who reside beyond its influence, he has found the health and longevity of the latter superior to those of the former. He has everywhere observed autumnal fever to be diminished by cultivation. The whole of this region lies in the coal basin.

VII. Region west of the Wabash.—In passing the river to the west, we enter on the vast prairies of Illinois. East of the Wabash they are subordinate to the wood-lands—west, the proportions are reversed. Of this region, a belt, two or three counties wide, extending from the summit-level between the waters of Lake Michigan and the Wabash, belongs to the basin we are now exploring. and is drained by the Embarras and Little Wabash Rivers, not to mention smaller tributaries. The upper beds of these fourteen or fifteen counties, consist almost entirely of diluvial pebbles, gravel, sand, and clay, with a covering of rich vegetable mold. The streams through such loose deposits, of course, have wide bottom-lands, nearly all of which are liable to inundation in times of high water. The surface of this region, whether wooded or woodless, is generally undulating or level, and scarcely anywhere broken into hills and ravines. The rigid grasses of the prairies retard the escape of rains and melted snows, while their long wiry roots bind the soil, and prevent the waters from excavating trenches through which they might flow off. Thus, extensive tracts of wet or marshy prairie are formed and maintained. Between these (many of which will be rendered dry by ditching, when the population becomes denser), and the low bottoms, which are irreclaimable, the whole of this extensive and fertile portion of the Wabash Basin is infested with autumnal fever, of which many cases assume a malignant and fatal character.* The mean latitude of this belt is 39° N.;—its elevation from seven to eight hundred feet above the sea.

SECTION X.

REMAINDER OF THE OHIO BASIN.

I. General Description.—Between the mouth of the Wabash and the Mississippi River there lies a range of counties, a notice of which will finish the description of the Ohio Basin. They are drained by Saline, Bay, and Cash Creeks; embrace but few prairies; and are generally covered with heavy forests, in the southern parts of which there are cane-brakes, and cypress swamps. The upper or northern counties—Hamilton, Franklin, Williamson, and Gallatin,—have a sandy surface, and abound in carboniferous limestone;—the sandstone which underlies the coal formation appearing here and there. The diluvium which overspreads the country further north, is here much reduced in quantity. The remainder of this district makes a part of the extensive alluvial region through which the Ohio unites itself with the Mississippi, and over which, when those rivers are in flood, their waters spread wide and deep; leaving, when they recede, large ponds and swamps.†

About six miles from the Ohio River, and running parallel with it, is an ancient bed of the Wabash, or of a part of that river. It is now a dense

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* Peck's Gazetteer of Illinois.

† Ibid.

cypress swamp, impassable, except in two places, and there by causeways. It extends from the Wabash to Saline Creek, eighteen or twenty miles, and when the Ohio River is swollen, a portion of its back-water takes the course of this ancient bed.*

As the region which has been briefly sketched lies in the mean latitude of thirty-seven degrees, and is elevated only about three hundred and fifty feet above the Gulf of Mexico, it is, of course, infested with dangerous autumnal fevers. We must say something of its principal town.

II. Shawneetown. — I am indebted to Doctor Roe for the following description of this locality:

"Shawneetown stands ten miles below the mouth of the Wabash, and eight miles above the mouth of Saline Creek. From one to the other, there is a range of fertile, heavily-timbered, sandstone hills, varying in their distance from the Ohio, from half a mile to three miles, or even more. At Shawneetown, they are distant a mile. In the river bottoms in front of these hills, there are a great number of lagoons or bayous. Those above the town are from one to three miles long, and from a hundred yards to a mile in width. Their depth is often considerable. During high water in the river, they all communicate with each other, and pour their waters, behind the town, into the lesser bayous below it. The town itself stands on higher ground than that behind it; but when the Ohio and Wabash are swollen at the same time, its entire site is overflowed. On the south or Kentucky side of the river, the hills opposite the mouth of the Wabash press close upon the shore, but soon recede, and a bottom, like that already described, is developed. Thus, the valley of the Ohio, through this region, is about four miles wide, and not unfrequently the whole of it is under water. The ponds left on the south side have in general muddy banks and sandy bottoms. Their water is clear and cool, and they are overshadowed with cypress trees. To return to the plain on which the town is built, I may state, that in the river bank, there is a conglomerate rock, abounding in sulphuret of iron, which undergoes a rapid decomposition, forming sulphate of iron. The wells of the plain afford different kinds of water, according to their depth; in some it is soft; in the greater number, hard. In digging a well, a mile from the river, near the foot of the hill, after having passed through sand, gravel, loam, blue clay, yellow clay, quick sand, and fine clay, they came to a stratum, four feet thick, of river mud, filled with logs, brush, and leaves, portions of the first being converted into beautiful lignite.

"Shawneetown has always been notorious as a 'sickly place.' In the year 1838, the State of Illinois employed a large number of laborers here, on the construction of a railroad. It was a sickly year; the town suffered dreadfully, and the operatives, who were strangers, still worse. A seventh part of them died, and nearly all were sick. But they dug an immense ditch, forty feet in depth, near the river, and deep enough generally to drain all the swamps and ponds in the vicinity of the town. The effect of this

* Doctor Roe.

measure on the autumnal health of the inhabitants was instantaneous, and has continued ever since. The fevers of that season no longer return; and when we have an occasional intermittent, it is generally in the spring. Nevertheless, a malignant case, called by the people a congestive chill, is now and then met with. Our worst disease is pneumonia, which will not bear the lancet, and often requires the sulphate of quinine. The fever still continues to prevail on the opposite side of the Ohio, where the swamps have not been drained."

III. CONCLUSION.—We have now finished the topographical survey of the Ohio Basin. If the reader has found it tedious, he should recollect its great superficies; extending from the sources of the southern tributaries of the Tennessee River, in Georgia and Alabama, to those of the Alleghany, in New York; and from the banks of the Mississippi River, in Illinois and Kentucky, to the Blue Ridge in Virginia. He should also remember its diversified geological constitution, from the tertiary deposits to the oldest Silurian or transition limestone. Still further he should meditate on the vast varieties of surface, necessarily presented by such a diversified geology. He should not forget the difference in altitude—nearly two thousand feet—between the alluvial bottoms of the Ohio, where it unites with the Mississippi, and the crests of the Appalachian Mountains, from which its rivulets descend. Finally, he should realize, that this great and fertile basin is, and ever must be, the most populous and important portion of the Interior Valley of North America; and thus he will be prepared to admit, that if there be, to the physician, any utility in this kind of study, any value in medical topography, geography, and geology, the time devoted to the Ohio Basin has not been misspent, nor the space allowed it greater than was demanded.

CHAPTER XI.

THE SOUTHERN BASIN, CONTINUED.

REGIONS EAST OF THE MISSISSIPPI RIVER, AND NORTH OF THE OHIO BASIN.

SECTION I.

GENERAL VIEWS.

The remainder of the Southern or Mexican Basin consists of a long, narrow belt, bounded, on the west, by the Mississippi, above the mouth of the Ohio; on the south-east, by the basin of the latter river; on the north-east, by the basin of the lakes; and, on the north, by the Hudson Basin. In length, the region on which we have now entered extends through ten degrees of latitude, that is, from the thirty-seventh to the forty-seventh. For the first five or six degrees its axis is directly north, when it turns to the north north-east, until it terminates at the interlocking sources of the Mississippi, the River Winipeg, and the St. Louis of Lake Superior. The average breadth of this long region is about two and half degrees of longitude. As its rivers, all tributary to the Mississippi, traverse it either obliquely or at right angles to its axis, they are, of course, short. The general aspect of the country which they drain is rolling, in some places flat, in none, except near the larger streams, hilly. Prairies abound in all parts. In fact, this is the great prairie-region of the eastern half of the Interior Valley. The lower, or southern third-part, lies within the Illinois coal formation, to which succeeds, in going north, the out-crop of older rocks to the primitive strata near the sources of the Mississippi. As to altitude above the sea, the southern part is lowest, rising, in general, from seven to eight hundred feet only, while, by a gradual increase of elevation, the northern extremity attains the hight of fifteen or eighteen hundred. The southern half lies in the State of Illinois, the northern, in Wisconsin. Large portions of this region are, as yet, either thinly peopled or quite unsettled, and hence a minute description would neither be practicable nor of much interest to the medical etiologist.

SECTION II.

BASIN OF THE KASKASKIA RIVER.

The Kaskaskia River joins the Mississippi one hundred miles above the mouth of the Ohio. Between the Ohio and the Kaskaskia, much of the country is somewhat broken, and abounds in forest more than prairie. The only stream worth notice is Big Muddy River, which presents abrupt wooded bluffs, with narrower bottom-lands than most of the rivers described in the last chapter.

The general course of Kaskaskia River is to the south-west. Its sources, and nearly all its tributaries, interlock with those of the Wabash, to the south-east, and the Illinois River to the north-west. Of the rivers which belong exclusively to the State of Illinois, this is the longest. The lower half of its basin abounds in wood-lands more than prairies; but in the upper half, the proportions are reversed, and the forest is chiefly found in the neighborhood of the streams. The former division, moreover, is dryer and more hilly, possesses a less fertile soil, and presents more rock at the surface. The latter, like the upper parts of the Wabash Basin, has its rocky strata buried up in diluvium from the north. In this region lies the Grand Prairie, the largest savanna east of the Mississippi River. The Kaskaskia and its tributaries are, throughout, alluvial streams, that is, have wide and low timbered bottom-lands, subject to inundations, which leave behind them ponds, marshes, and all other varieties of wet surface, overspread with the wreck of their luxuriant vegetation. Such a surface, in the mean latitude of thirty nine degrees, must of necessity give rise to severe autumnal fevers, which are known to prevail throughout the whole Kaskaskia Basin.

SECTION III.

BASIN OF THE ILLINOIS RIVER.

I. Outline Description. — The head-waters of Illinois River approach the southern end of Lake Michigan. On the western side of that lake, and within a few miles of its shores, the River *Des Plaines* originates, and flows to the south, nearly parallel to the same shores. This is one of the elementary streams of the Illinois; the other is the Kankakee. The sources of the latter are near the middle of the northern boundary of the State of Indiana, to the east of Lake Michigan, whence it winds round the end of the lake and flows westerly, until it joins the Des Plaines to form the Illinois. That river then bears off to the south-west and south, to join the Mississippi, twenty miles above the mouth of the Missouri River. Not far below its head the Illinois receives, through its right bank, the waters of Fox River, a large tributary, which originates near Lake Michigan, almost as far north as Milwaukie, in the State of Wisconsin. Below Fox River, all the northern and western tributaries of the Illinois are of very limited extent, as its basin is compressed on those sides, first by Rock River and afterward by the Mississippi; the former of which, the Illinois approaches at an acute angle, a short distance above the town of Hennepin. On its southern side the basin of the Illinois is much broader, and the tributary streams more numerous, of which the most important is the Sangamon. The upper portions of the Wabash and Kaskaskia basins prefigure to us that which we have now entered. Interminable undulating prairies, dry, wet, and marshy, interspersed with groves, and intersected by streams whose wide and low bottoms are overshadowed with trees, characterize every part of the basin. The southern portions are within the coal formation, the northern and north-eastern rest on extensive level out-crops of the Devonian and Silurian rocks, which emerge from beneath the coal. In almost every part of the basin there are deep and extensive deposits of drift from the north. The great depression of the coast of Lake Michigan, at its southern extremity, has been already pointed out, and suggests that, for ages after Lake Erie ceased to send any portion of its waters into the Ohio, a great river continued to flow from Lake Michigan through the valley of the Illinois, into the Mississippi. Recently, a canal has re-established a water communication between the latter river and that lake; which, with the fertility and beautiful aspects of the Illinois Basin, must quickly raise it to a distinction that will impart great interest to its medical topography. With these general observations, let us proceed to the study of particular localities.

II. Lower part of the Illinois River. — In the month of September, 1844, about two months after the great flood, I ascended the Illinois River eighty-four miles, to Meredosia, and had an opportunity of observing that the deposits which it left on the surface of the broad bottom-lands, were argillaceous, instead of being sandy, like those of the Missouri River, on the opposite side of the Mississippi. The grass and annual herbage, with much of the shrubbery, and many forest trees. had been killed by the submersion. Of the trees, the white hickory (*Carya porcina*) suffered most. This was an extraordinary flood; but the uncultivated state of the bottoms, generally, indicates that they are liable to annual inundation. On one side or the other of the trench through which the river flows, there is a bluff of sub-carboniferous limestone or Devonian sandstone rocks; on the opposite, a low, wooded bottom, abounding in extensive lagoons, ponds, and swamps. There are, however, within the trench, many old and high diluvial terraces, that are never overflowed.

One of these terraces constitutes the site of Meredosia; in traversing which, on the road to Jacksonville, we travel over a sandy surface, then descend a little upon a fertile prairie, and then ascend a bluff, from which the view down the valley confirms what has just been said, as it discloses great breadth, with low prairies and wood-lands, abounding in pools and marshes. It seems almost superfluous to say, that the population along such a valley are subject to grave autumnal fevers.

III. Jacksonville. — From the river to Jacksonville, twenty miles east of Meredosia, the road passes through Morgan County, one of the most populous of the state. The fertile surface is undulating and dry, and presents a continued series of groves and prairies. The strata beneath are composed of carboniferous limestone, and the water is hard. The site of Jacksonville is an elevated undulating prairie, around which, to the east and north, at the distance of a mile, a sluggish stream, with oak-timbered banks, winds its way to Mauvaiseterre Creek, a tributary of Illinois River. The settlement of this town was begun in the year 1825. It is the seat of the Illinois College, and of the State Institution for the education of the deaf and dumb. From Doctor Jones I learned, that all the forms of autumnal fever occur at this place. Malignant intermittents are rare — remittents, tending to a continued type, rather frequent. Doctor Prosser informed me, that the prevalence of these fevers is much less than formerly. Doctor Smith thought them not more frequent and fatal than he had seen them in the basin of Licking River, Kentucky. Doctor English found them more malignant than he had seen them in the lower valley of the Great Kenawha, in Virginia. On the whole, they prevail here in a mitigated degree, compared with the surrounding region generally, and thus conform to its, apparently, salubrious character.

IV. Springfield. — The road from Jacksonville to Springfield — the capital of the State of Illinois — runs directly east, through Morgan and Sangamon counties. The distance is thirty-six miles. The country has an elevated aspect, is gently rolling, and presents groves and prairies in alternation, with a predominance of the latter. In some places, the surface is so wet as to require the roads to be thrown up in the middle; but not a pond nor marsh is to be seen on the whole route. Autumnal fever prevails, but not with such violence as to have prevented a very rapid settlement of the country, and its successful cultivation.

Springfield is situate near the center of the Valley or Basin of Sangamon River, the most important tributary of the Illinois, in N. Lat. 39° 48′, and W. Lon. 89° 33′. This valley, formerly called the 'Sangamon Country,' is to the State of Illinois, what the valley of the Elkhorn is to the State of Kentucky. A gently rolling surface; numerous streams, which continue to flow through the summer and autumn; a deep and fertile argillaceous soil; extensive prairies, with groves and copses of fine forest; no great extent of inundated bottom-lands, and but few ponds or swamps; constitute its topographical excellencies. Its altitude above the sea is from seven to eight hundred feet. Springfield need not detain us long. The margin and gentle slope of a prairie constitutes its site, with a small stream, along which are open wood-lands, meandering to its west through a rocky channel. Although the conditions requisite to the production of autumnal fever do not seem greatly to abound in the basin of the Sangamon, yet, Doctor Todd, Doctor Henry, Doctor Merriman, and Doctor Jayne, all of Springfield, assured me of its prevalence; and during my sojourn in that city, they afforded me an opportunity of seeing intermittents, as malignant as those which occur on the banks of the Tuscaloosa or Pearl River, seven degrees of latitude further south.

V. Bloomington. — In advancing northerly from Springfield, toward

Lake Michigan, the proportion of prairie to wood-land increases. The latter is almost confined to the streams, where it exists in narrow belts. All the larger groves have specific names, as, in regions where the forest predominates, the prairies have received them. The quantity of drift and bowlders increases, and the rocky strata are more buried up. The narrow alluvial bottoms are subject to inundation. The surface is gently rolling, and susceptible of being rendered dry by ditching and cultivation; but in the natural state many of the prairies are wet or marshy. Such is the general character of the country from Springfield to Bloomington, a distance of sixty miles. Its population is sparse. Autumnal fever prevails annually. One of its citizens informed me, that he had resided where I found him three years, before a member of his family was seized with that fever. Such instances are not uncommon, though difficult to explain.

In its topography, the village of Bloomington presents nothing worthy of notice. Prairies surround it, and small head-streams of Kickapoo Creek, which ultimately throw their waters into the Sangamon, are found near it, and supply an adequate amount of wood-land. Doctor Henry, now of Burlington, Iowa, who had resided in the place ten years, regarded it as but little infested with autumnal fever; and spoke of the surrounding country as not being scourged to any great extent. He had become convinced that an extensive plowing up of the soil of the prairies for the first time had been followed by fever; especially in those who resided on the northern or leeward side of such tracts. He had rarely seen malignant cases. These statements were confirmed by Doctor Colburn, of Bloomington.

VI. From Bloomington to Peoria. — The distance between these places is about forty miles — the course almost west. For the first ten miles, the rolling prairies are interspersed with narrow belts of wood-land, along the head streams of Kickapoo and Sugar Creeks,— waters which belong to the Sangamon Basin. Diluvial or post-tertiary deposits of sand, gravel, and clay, with erratic bowlders, bury up the carboniferous rocks. The sparse population is moderately affected with autumnal fever. Passing beyond the waters of Sugar Creek, we come on the dividing lands between it and Mackinaw Creek, a tributary of the Illinois. For many miles this tract presents a high, rolling, argillaceous surface, with scattered oak trees and prairie herbage, to the village of Mackinaw, on the western side of which is the creek of that name. The physician of the village, Doctor Burns, who had formerly resided on White River, in the State of Indiana, told me, that there was autumnal fever 'here and there.' Beyond Mackinaw Creek (which has a lively current), the same aspect of country continues for ten miles, when the road descends into an extensive level prairie, on the western side of which is the village of Washington, the inhabitants of which, in the middle of September, wore the appearance of good health. From Washington to the immediate valley of Illinois River, the road lies over rolling forest land, with but few inhabitants, and I had no opportunity of comparing its autumnal salubrity with that of the prairies.

VII. Peoria. — An expansion of the Illinois River to three or four times its usual breadth, through a length of nearly twenty miles, constitutes what is called Peoria Lake, which is almost without a perceptible current. On the west bank, near the lower or southern end of this expansion, is the beautiful site of the town of Peoria, in N. Lat. 40° 40′. The plain rises gradually for a quarter of a mile, then declines a little for the same distance, and is terminated by an abrupt bluff, the summit of which is from eighty to one hundred feet above the surface of the river. From this bluff a rolling prairie and wood-land plain stretches off to the west. Both the upper and the lower terraces are composed of northern drift or diluvium, burying up the carboniferous rocks. Below the town the bluffs recede, so as to give greater width of bottom-land, which at the same time becomes more depressed; — but little of it, however, suffers inundation. On the opposite or eastern side of the river, the bottom is two miles wide, heavily timbered, and subject to overflows of the river; but this tract is to the summer-leeward of the town.

The Anglo-American town of Peoria is of such recent settlement that, in the year 1833, it contained not more than twenty-five families; * but it had been previously inhabited by the French, who selected it as the site of one of their earliest missions in the Great Interior Valley. In 1779 it began to be a village of Indian traders, voyageurs, and hunters; but such classes of persons would do little toward those transformations of the surface, which modify the public health, and are of interest to the etiologist. Hence, although so old a settlement, its autumnal diseases are substantially the same as those of the recently settled parts of the region we are describing. From Doctor Dickinson, Doctor Rouse, and Doctor Frye, I collected that, in and around the town, intermittents and remittents prevail every year, but to a greater extent in the latter than the former. Mr. Armstrong, an immigrant from Ohio, who established himself on the bluffs in the rear of the town, told me that he and nearly all his family were attacked with intermittents the first year of their residence there.

From Doctor Frye I obtained the following facts, which, however, belong to other localities:

In a part of Tazewell county on the opposite side of the river, a number of families from Ohio formed what was called the Moobury Settlement. For two years, the land they cultivated was at the distance of a few miles from their habitations. They then plowed up the prairie near their residences, and in the following autumn, experienced a decided invasion of remittent fever, while the surrounding population remained healthy. In Peoria county, a number of families had settled (as is common) on the margin of a large prairie, and remained healthy in autumn. At length, a little colony arrived, and establishing themselves near each other, enjoyed excellent health the first year; but the next spring, they broke up a large extent of prairie, near their dwellings, and suffered severely in autumn from fever, while the country around remained comparatively healthy. Doctor Frye has

* Peck's Gazetteer of Illinois.

remarked here, what has been noticed elsewhere, that in low and wet timbered spots the intermittent form of fever is more prevalent than the remittent; — also, that in some autumns every kind of locality is affected, while, in others, some places suffer and others escape.

VIII. Peru and La Salle. — These are two recently settled towns, above Peoria, where the canal from Lake Michigan has its final termination. They are situate within a mile of each other, on a narrow strip of bottom, and on the adjacent bluffs. On the opposite or left bank of the river, there is a bottom, a mile in width, which is overflowed when the river rises high. The principal physician, Doctor Whitehead, in a residence of eight years, had seen autumnal fever, as an epidemic, in two years only; and then it prevailed chiefly among immigrants from the north, and Irish laborers on the canal.

IX. Ottawa. — From the last towns to this, a distance of sixteen miles, the immediate valley of the Illinois is, in general, about a mile in width, and bounded by rocky bluffs of sandstone, schistose clay, and limestone. These bluffs rise in precipices about one hundred feet high, and are thinly covered with trees. The intervening bottom-lands are chiefly prairie, and so low as to be annually overflowed.

The town of Ottawa is built on the right or north side of the Illinois River, immediately below the mouth of Fox River. There is, first, a narrow slip of bottom, liable to submersion; then a higher alluvial terrace, on which the town is built, on the rear of which runs the canal, and immediately beyond are the bluffs. On the opposite or left-hand side, the river flows near to the cliffs. On each side, it may be seen that the rolling prairies rise still higher than the bluffs. From Doctors Howland, Schermerhorn, and Hurlbert, I learned that autumnal fever is common in this locality, and that malignant intermittents are not unknown. The Irish laborers on the canal had suffered greatly. The two autumns in which the excavations were going forward, were the sickliest that Doctor Howland had known at this place; but, as the sickness prevailed in the adjoining country, it could not be said to depend on the excavation. The same gentleman had observed that persons living in the open prairies, are healthier in autumn than those who reside near the wood-lands; which may be owing to greater humidity in the latter, as the trees are chiefly in the neighborhood of streams. He had also seen some proofs, that the first plowing up of the prairies is followed by fever.

X. From Ottawa to Juliet. — In leaving Ottawa, the road passes out of the Illinois trench, which here lies east and west, and takes a north-east course, over the dividing lands between Fox River on the west, and the Illinois on the east. The country is elevated, dry, and long-undulating. The streams are few and small. The prairies here spread out into vast dimensions, and, of course, the proportion of wood-land is correspondingly small. Peru and Ottawa are barely within the northern verge of the Illinois coal basin; for, at the distance of twenty miles north-east of the latter, the upper Silurian limestone, lying (geologically) far beneath the coal measures, becomes the surface-rock, and so continues to the northern sources of the Illinois River. From the best information I could obtain in reference to this tract, autumnal fever is both rare and mild; proportionate, in fact, to the limited extent of those topographical conditions on which it is supposed to depend.

XI. Juliet.*— This, like all the towns of the Illinois basin, is of recent settlement. It stands on both sides of the Des Plaines, already mentioned as the northern of two rivers, which, by their union, form the Illinois. A dam across the Des Plaines forms a pond for mill purposes, and to supply the canal. The bed and banks consist of the limestone rock, just mentioned. On the west or right side of the river, there is only terrace enough for a single street; on the opposite side there is a broad rocky flat, resembling the site of Nashville on the Cumberland River. Its surface is above high-water mark. Beyond it is another terrace rising a little higher, and composed of gravel, bowlders, and other varieties of northern drift, which are abundant in the valley of the Des Plaines. There are no drowned lands near the town. From the account given me by Doctor Scholfield and Doctor Bowen, this locality, the latitude of which is about 41° 30′ N., and its elevation a little below that of Lake Michigan, is annually invaded by autumnal fever, though it seldom assumes either a wide-spreading or fatal character. The Irish laborers on the canal, in 1838 and 1839, as at Peru and Ottawa, were the greatest sufferers.

The road from Juliet to Chicago runs a north-east course, on the west side of the Des Plaines, but not in its immediate valley. The aspect of the country is almost identical with that from Ottawa to Juliet. At the distance of twenty-seven or twenty-eight miles, it descends from these elevated rolling limestone prairies, on which there are occasional deposits of drift, to the Des Plaines, which is found flowing to the south, through what was once an arm or small bay of Lake Michigan, and is now elevated but a few feet above the lake surface. The breadth of this plain, from the river to the lake shore at Chicago, is about twelve miles. Its description can be best given in connection with the Basin of the Lakes.

XII. Kankakee River. — This is the larger of the two streams, which, by their junction above the town of Ottawa, form the Illinois. I can say nothing of its topography from personal observation. It traverses Indiana and Illinois from east to west, immediately in the rear of the sand-dunes which surround the southern shore of Lake Michigan. There is a water communication between the sources of this river and the St. Josephs, not far from the entrance of the latter, into Lake Michigan. For a great portion of its whole length, the Kankakee flows through broad swampy prairies; afterward its channel becomes rocky, and its current more rapid.† Before it reaches the Des Plaines, it passes through a more wooded country. As yet the basin of the Kankakee is but thinly peopled, and I cannot speak of its fevers.

* Properly Joliet.

† Peck's Gazetteer.

SECTION IV.

BASIN OF ROCK RIVER.

I. In ascending the Mississippi we come to the mouth of Rock River, three hundred miles above the junction of the Illinois, in N. Lat. 41° 32′. The southern or lower part of this basin, lying within the State of Illinois, is compressed into narrow limits, by the Mississippi on the north-west, and the Illinois on the south-east; but the upper or northern portion expands nearly across the southern part of Wisconsin. The extreme sources of this river are found immediately south of Lake Winnebago, near the forty-fourth degree of latitude. Some of its upper waters originate near Lake Michigan, north of Milwaukie; others in the neighborhood of Wisconsin River; while others are found near the Mississippi. Thus, the Rock River Basin covers north-western Illinois and most southern Wisconsin — newly-settled regions of great prospective interest. The north-eastern portions of this basin abound in small lakes, most of which have outlets. It also has prairie-marshes, one of which, called the Winnebago marsh, has an area of forty square miles.* According to Peck,† this region is overspread with swamps and quagmires, relieved by ridges of sand bearing shrubby oak, or tracts of rich, dry, undulating land. Shaking prairies (*Terre tremblant*) are also common. In traversing this basin from Milwaukie on the lake, to Galena near the Mississippi, under the forty-third parallel, I remarked that after passing through the belt of lofty forest, twelve or fourteen miles wide, which the atmosphere of the lake has quickened into growth, prairies began to appear, on the banks of Fox River, a branch of the Illinois. A well, by the road side, was eighty feet deep, its whole depth being through a bed of drift or transported materials. Soon after crossing Fox River, we passed out of the dense miscellaneous forest, of which the sugar-maple was the predominant tree, and entered open oak wood-lands, interspersed with prairie. In a short time we reached the Basin of Rock River. The country then gradually became more thinly timbered. Many of the oaks resembled the live-oaks on the Mexican coasts. Deposits of drift were extensive, and great primitive bowlders numerous; but here and there the Silurian limestone showed itself in cliffs; the prairies were generally dry; ponds and small lakes now and then appeared; the surface was rolling, and the small streams flowed with lively currents. The descent to Rock River, where Fort Atkinson once stood, was very gentle; beyond that stream, the country became more rolling, and seemed a little more elevated; no dense forest reappeared, yet the trees, for some distance, were larger. Although the surface was in the main dry, spots of wet prairie were occasionally seen; which aspects continued to —

II. The Four Lakes. — These little lakes lie in a chain, with a lively current from one to the other. The outlet from the first, or most southern,

* Lapham's Wisconsin. † Gazetteer of Illinois.

is called Catfish. The area of this lake, according to Captain Cram, United States Topographical Engineer, is five square miles. The water is pellucid. The shores are rolling and uneven, being broken by low bluffs, and interspersed, occasionally, with small marshes. The timber is scanty. The second lake, lying north of the first, has an area of seven square miles. On the north and east, the shore is marshy, with a low gravelly bank intervening between the marsh and the water's edge; on the southern and western shores the land is elevated, undulating, and in some places even knobby. The third lake is intermediate in size and position, between the second and fourth. Its area is six square miles. Its banks are high and undulating, with a scattered growth of oak trees. The fourth or most northern lake covers an area of more than fifteen square miles. The land bordering it is undulating, hilly, and, in many places, broken. Its north side is well timbered. Its shores are overspread with white gravel. Many springs pour into it their pure waters; and it has one small tributary stream, which originates within a few miles of Wisconsin River. The basis of these lakes is a flinty Silurian limestone. The difference in level between the first, or lowest, and the fourth, is about four feet. The elevation of the fourth is estimated, by Captain Cram, at two hundred and ten feet over the surface of Lake Michigan, or seven hundred and eighty-eight above the sea.*

III. MADISON, the young capital of the State of Wisconsin, stands on a neck of land between the third and fourth of the lakes just described, on the west side of the stream which connects them. It fronts on the third lake, from which the ground rises gradually to the hight of thirty feet, and is free from marshes. Its Lat. is 43° 5′ N.,—its Lon. 89° 6′ 30″ W.†

IV. AUTUMNAL FEVER.—We have now reached a latitude, in which climate may be supposed, in some degree, to overrule topographical conditions, in the production of autumnal fever; and the question comes up—Is its influence perceptible in the region which has just been described? It is not easy to give a definite answer to this inquiry, for the reason, that the alleged sources of that fever do not, to any great extent, exist within its limits. Yet, from all I could learn, the prevalence of the fever is decidedly less than we find it further south, in localities having nearly the same topography and elevation. At the crossings of Rock River, I was assured by Mr. Foster, that a few mild intermittents make up the sum total of an autumnal invasion; and Doctor Western, of Madison, gave a similar account of that town. He informed me, however, that there had been one sickly autumn at Madison, and one on Rock River, twenty miles below the crossings, at Janesville, which is built on a slip of bottom-land.

V. THE BLUE MOUND REGION.—In going westwardly from Madison, the country gradually rises into the water-shed between Rock River and the Wisconsin, though the road still keeps within the basin of the former. The surface is broadly undulating. No more diluvium or drift of any kind is

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* Lapham's Wisconsin.

† Owen & Locke's Geological Report.

found upon it. The soil or upper surface is composed largely of the disintegrated Silurian rocks, undecayed portions of which are seen, like lofty monuments, rising over the face of the country. They have received specific names, of which the most noted are the Blue Mounds. Ponds and marshes are no longer met with; there is no dense forest; and extensive prairies abound. The grass which covers them is short and thin, like that of the savannas beyond the Mississippi, and the golden *Solidago*, which gives autumnal beauty to prairies not too deficient in moisture to nourish it, is here replaced by a small bluish-purple aster, which flourishes where the soil is dry. The habitations throughout this region are sparse; and, from all I could learn, intermittent and remittent fevers are exceedingly rare.

VI. Dodgeville. — This lead-mining village, situated in the region which has just been described, presents in its topography small streams, without much alluvial bottom, and long gentle slopes, partly covered with prairie grass, and partly with open oak woods, or copses of hazle bushes. From Governor Dodge, who had resided here about sixteen years, I learned that autumnal fever is almost unkrown; a statement which was confirmed by Mrs. Black, an observing and intelligent lady, who had lived on the spot for nearly the same length of time. The mining population of the village and its neighborhood is about five hundred, — chiefly immigrants from England.

VII. Mineral Point is found ten miles south of Dodgeville; the country between presenting prairie, and open woods covering long slopes and ridges. The streams are generally small. Mineral Point, however, is on the banks and adjoining hills of a creek, sufficiently large to move the machinery required in the smelting of lead ore; and which is joined, below the village, by another of the same size — the common trunk opening into the Peckatonica, one of the tributaries of Rock River. There are no ponds or marshes around Mineral Point, but the stream along which the town is built presents some narrow belts of boggy soil. The population of this town is about one thousand. According to Doctor Pulford, the people who live near the stream below the town are subject to autumnal fever, from which the inhabitants of the town itself are not entirely exempt. This liability, compared with that of the people of Dodgeville, seems to result entirely from the presence of water-courses in this locality, and their absence from that. The Peckatonica is the most western stream of the Rock River Basin, and interlocks with the head-waters of Fever River, and other small tributaries of the Mississippi. According to Lapham, its waters are turbid and its current sluggish; but of the influence of its valley in the production of autumnal fever I know nothing. Nor can I speak of the medical topography of the lower portions of Rock River Basin, lying within the State of Illinois, which, however, are of no great extent.

SECTION V.

REMAINDER OF THE SOUTHERN BASIN.

I. THE WISCONSIN RIVER. — Although there are many interlockings between the tributaries of Rock River and the Wisconsin, the latter enters the Mississippi more than two hundred miles above the former, about the forty-third degree of latitude; while its extreme sources are near the forty-sixth degree, in connection with streams which flow into Green Bay and Lake Superior. For two-thirds of its course, it flows to the south, and then turns almost as directly west. At this elbow or *detour*, it approaches within a mile and a half of Fox River, a tributary of Green Bay. The Wisconsin Basin is very long, compared with its breadth. Although this is the river, down which the upper Mississippi was approached and discovered, by Father Marquette, one hundred and seventy-five years ago, there are very few settlements above the elbow; and none of any importance to the medical topographer below that bend. North and west of Wisconsin River, the large remainder of the Mississippi Basin is almost an unreclaimed and unsettled region. The first considerable river beyond that we are now examining, is the Chippeway, of which I cannot say anything. Of the next — the St. Croix — I am enabled to speak briefly, on the authority of Doctor Shumard, Assistant United States' Geologist.

II. RIVER AND LAKE OF ST. CROIX. — The river St. Croix has its origin in a great number of small lakes, immediately south of the west end of Lake Superior, above the forty-sixth degree of north latitude, and, after flowing to the south-west for half its course, turns directly south, until it joins the Mississippi, which it finds running to the south-east. The place of junction is only ten miles below the mouth of the St. Peter's, in Lat. 44° 45′ 30″ N., and at an elevation above the sea of seven hundred and twenty-nine feet; that of the neighboring hills being eight hundred and sixty-six feet.* Through its lower thirty miles, the current is almost imperceptible, and the surface of the stream is expanded to half a mile or a mile in width. This constitutes the lake, the shores of which present many bowlders, reposing on old Silurian rocks of magnesian limestone and sandstone. One of the hills near the lake rises to the hight of three hundred and forty-nine feet above its surface, or ten hundred and seventy feet above the sea.

STILLWATER, the only settlement on this lake, is a new village, on the western side, near its head, containing about five hundred inhabitants. It stands on a dry plain, which slopes from the bluffs to the water's edge. Immediately to the north, there are swales which are kept up by spring-water, and in the contiguous river-bottoms there is some marshy ground; — both, however, lie to the summer-windward of the village. As to autumnal fever, Doctor Shumard learned from the physician of the place, that intermittents of a mild character occur every year, but the proportion of cases to the population is small.

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* Nicollet: Hydrographical Basin.

THE FALLS. — The other settlement on the St. Croix is at the falls or rapids, about thirty miles above Stillwater, in Lat. 45° 30′ 10″ N. The descent of the river is over trap-rocks, ranges of which begin to show themselves twenty-four miles above the lake. For several miles above the lakes the sandstone hills approach the river, but beyond that point the bottoms widen and become swampy, and are overshadowed with cotton-wood and maple trees, the hills abounding in pine. There is a pine saw-mill at the falls, and the pine lumber trade is the object of this settlement, the most northern in the basin of the Mississippi. Doctor Shumard ascertained that a few cases of intermittent fever happen here every autumn. The tributaries of this river abound in trout. The neck of land between the St. Croix and the Mississippi presents a succession of small lakes and tamarack swamps, with interspersed tracts of dry land, clothed with scrubby oaks and hazle bushes.

It appears from what has been said, that we have not yet reached the limit of sporadic intermittent fever, in the southern basin; but have passed beyond the line of its epidemic prevalence.

III. SOURCES OF THE MISSISSIPPI. — The St. Croix, just described, is the last considerable tributary of the east or left side of the Mississippi. Ten miles above its mouth we come, on the opposite or western side, to the junction of the St. Peter's, above which stands Fort Snelling, the most northern post of the Southern Basin. Nine or ten miles above, are the Falls of St. Anthony, where the surface of the river is eight hundred and fifty-six feet, and that of the hill-land about one thousand feet, above the Gulf of Mexico. This elevation of the river has been attained through sixteen degrees of latitude. Two degrees and a half further north (47° 30′), bring us to the extreme sources of the river, where the water-level is fifteen hundred and thirty-two, and the highest land sixteen hundred and eighty feet. This rapid ascent indicates that above the Falls of St. Anthony there is a great swell or tuberosity, on the gentle slopes and summit of which the great river has its sources. The width of this region is about two and a half degrees of longitude. On the west, it is limited by the St. Peters, and Red River of the north; on the east by the St. Louis, and other short tributaries of the west end of Lake Superior. From the expeditions of Pike, Cass, and Schoolcraft, but, above all, from the hydrographical map of Nicollet, it appears, that the whole of this region abounds in swamps, ponds, and small lakes, connected by bayous into the most remarkable hydrographical labyrinth, to be found within the limits of the Southern Basin. As yet it is unsettled, except by a few fur-traders and missionaries, whose business is with the Indians. Of the extent to which autumnal fever occurs among them, I cannot speak; but it must be very limited. At Mackinac, in 1842, I met with an educated Indian — John Johnson, attached to the Methodist Mission family, stationed near the American Fur Company's establishment, on the banks of Sandy Lake, about Lat. 46° 48′ N., — who informed me that ague and fever occasionally occurred among them. The altitude of that lake, according to Nicollet, is twelve hundred and fifty-three feet above the gulf.

The medical topography of the Southern Basin is now brought to a close. Although it has extended through more than three hundred pages, a very small portion of its localities have been described; yet enough I hope have been introduced, to afford a tolerable representation of the whole. Beginning within the tropics, we have traveled north through nearly thirty degrees of latitude, and gradually risen from the level of the Gulf of Mexico, to the summit of the great interior hydrographical center, the average elevation of which may be taken at fifteen hundred feet.

From this important interior hydrographical center, we are now to descend eastwardly into the Lake, St. Lawrence, or Eastern Basin.

CHAPTER XII.

THE EASTERN, OR ST. LAWRENCE HYDROGRAPHICAL BASIN.

GENERAL VIEWS OF THE WHOLE BASIN: LAKES SUPERIOR, MICHIGAN, AND HURON.

THE limits of this basin have been already drawn (*p.* 29). Its position in relation to the center of the Mexican or Southern Basin, is northeast. Most of it lies directly north of the Ohio Basin. In reference to latitudes, it may be said, in general terms, to be comprehended between the fortieth and fiftieth parallels. On many points besides latitude, it differs from the basin which has been topographically described. That basin is without a single large lake — this includes a chain of the largest on the continent: that has an extensive *sea*-coast — this has a still more extended *lake*-coast: that is distinguished for the vast length and volume of its numerous rivers — this has not one large river, save the St. Lawrence — the outlet of the lakes: that is bounded on the west, through its whole extent, by many ranges of high mountains — this has a plain of immense extent on the same side: large portions of that present an arid surface, and are destitute of trees — this is everywhere humid and generally overshadowed by forests, interspersed with a few savannas: the southern population of the Great Interior Valley belongs to that — the northern population to this: in that, the etiologist may study the influences of a wet surface, abounding in organic matter, when acted upon by the heat of a long southern summer — in this, the same influences, in a summer comparatively short and cool. In making this comparison, however, we are prevented, by want of population, from going at present beyond the latitude of 47°.

In describing the Southern Basin, we started from the Gulf of Mexico, and ascended the great rivers. By this method, the description terminated with that portion which lies contiguous to the extreme sources of the St. Lawrence, which — under the name of the River St. Louis — throws its waters into the western extremity of Lake Superior; — and here we shall begin the medico-topographical description of the Eastern Basin; thus reversing the order pursued in the Southern, by descending to the sea, instead of rising from it; and at the same time advancing with unbroken continuity.

SECTION I.

BASIN OF LAKE SUPERIOR.

I. This is the largest lake of the continent, and the most northern and western of those included in the St. Lawrence Basin. Its southern affluents interlock with those of Lake Michigan, Green Bay, and the Mississippi River; its western with those of that river only; its northern with those of Hudson Bay; its eastern with streams which fall into Lake Huron.

The area of Lake Superior is estimated at thirty-two thousand square miles, most of which lies between the forty-seventh and forty-eighth parallels of latitude; its mean depth is about nine hundred feet. Its level above the sea, according to the geologists of Michigan,* is five hundred and ninety-six feet, according to Nicollet, six hundred and twenty.† The average altitude of the country around it, may be taken at one thousand feet more, or sixteen hundred above tide-water in the Gulf of St. Lawrence. The basin of this lake lies distinctly within the primitive or oldest transition rocks, with extensive trap formations. In contrasting the coasts of this inland sea with those of the Gulf of Mexico, we find them lofty, bold, rocky, and metalliferous; while the latter are low, flat, and swampy. Lake Superior, however, is not without coast-marshes; and some of its rivers overflow their banks, near their entrance into the lake. In the month of July, Mr. Schoolcraft found its mean surface-temperature, on the south side, 61° Fahrenheit.‡ The country around Lake Superior is a vast, rugged, and uninhabited wilderness, but there are a few settlements, to which reference may be made.

* Second report.

† Hydrographical Basin.

‡ Nar. Journal of Travels, 1821.

II. Fort William.— The British North-west Company have an establishment near the mouth of Dog or Kaministiquia River, in Lat. 48° 24′ N., called Fort William. According to Long,* a plain of considerable extent surrounds this village, which is on the river bank, a mile from the lake. This was once an important depot for the fur trade, and was inhabited by eighty partners and clerks of the company, many of whom had families. In latter years, the population has been less. In consulting every authority within my reach, I find no reference to autumnal fever at this place; and Doctor Rowand, late of Quebec, who has several times sojourned there, assures me that intermittents and remittents are unknown.

III. River St. Louis, and Fond du lac.— This river originates on the high summit-level west of Lake Superior, and descends, by a series of falls and rapids, to the western extremity of the Lake. It may be regarded as the beginning of the St. Lawrence, and is the highway of the *voyageurs* of the American Fur Company. On its estuary is the establishment called Fond du Lac, in Lat. 46° 40′.† I cannot find in any book of voyages or travels, a reference to autumnal fever, as occurring in this locality.

IV. Southern Coast — Copper Region.— Within the last few years, the copper region on the southern coast of Lake Superior, has been the resort and summer residence of a great number of persons, who have led there lives of great exposure. I have not learned that autumnal fever has been one of their diseases; on the contrary, Mr. Charles Whittlesey, of Ohio, topographical surveyor, writes to me as follows:—"The exposure I underwent, on the southern shore, this fall (1845), would have ended in ague and fever, or some other bilious attack, almost anywhere south of Lake Erie; but here, my companions and myself not only escaped that disease, but enjoyed extraordinary health. We followed the coast westwardly, from the St. Mary, in an open boat, and, with the exception of a friend, who started with his system overflowing with bile, no ailment was felt by any of us. From the 13th of September to the 13th of October, we were in the woods; the season was rainy, and we were often wet for several days together, with no covering at night, except our blankets; yet we never felt better. Much of the land we wandered over was high, rolling, and heavily timbered with sugar maple; there are, also, low lands and cedar swamps, but they send up no miasma, and their waters served us for drinking and cooking, as well as those of running brooks. The latter are cold and rapid, with rocky beds, and it is only necessary for me to add that they abound in speckled trout, to show you that they are as pure as any waters that flow." The average latitude of the region in which these observations were made, is 46° 30′ N.

V. St. Mary Straits.— The outlet of Lake Superior, is at its eastern extremity, and known under the name of St. Mary Straits or River. Its efflux is at the base of a rounded, rocky promontory, on the British side,

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*Second Expedition, Vol. II. † Nicollet.

known by the voyageurs as *Gros Cap*. The gentle current of the St. Mary flows in a shallow sand and gravel trench, varying from half a mile to two miles in width. The banks, nearly uninhabited, are low, in many places wet, and, throughout, heavily timbered with pine, hemlock, maple, and other trees. At the distance of sixteen miles, we reach the falls, or *Sault de Ste. Marie*,* where the river descends eighteen feet, down a broad inclined plain, overspread with vast granitic bowlders, solitary or in island-groups, at the foot of which, on the British side, there is a small settlement;—on the American side, an inconsiderable fur-trading village, and a military post.

Fort Brady, stands in N. Lat. 46° 39′, and W. Lon. 84° 43′. "The right bank of the St. Mary, which is here three-fourths of a mile in width, presents a gradual slope for the distance of two hundred and fifty feet, gaining in that space an elevation of fourteen feet, in the rear of which the surface of the country approximates a level. For three hundred yards from the bank of the river, the soil is cleared of timber, and is, although not very productive, in a state of cultivation. Immediately adjoining this cultivated ground, is a marsh, half a mile wide, beyond which high lands appear. This marsh extends five or six miles down the river, in a south-east direction, and west and south-west for fifteen or twenty miles. It is covered with some large forest trees, and a thick growth of under-wood. On the opposite side of the river, the country is undulating and mountainous, and covered with a dense forest." "The west and south-east winds pass over the marshes."†

It is undeniable, that all the topographical conditions necessary to the production of violent autumnal fever, are present in this locality; which includes, in addition to the garrison, a village inhabited or frequented by Americans, French voyaguers, and Indians, with their intermediate progeny. My visit was in the last week of July, yet I saw no autumnal fever, and was assured by persons long familiar with the spot, that it does not occur, except in persons who have, in summer or autumn, visited places further south. The returns from the post, however, show that the troops are not entirely exempt. Thus, through a period of ten years, with a mean strength of ninety-six men, there were, in all, thirty-seven cases of intermittent, and three of remittent, or about four per cent. *per annum*. When we connect with this low ratio, the facts, that troops are seldom kept long at one post, and that relapses into intermittent fever may continue to occur for a long time after the first attack, we are, perhaps, at liberty to suppose, that most of those reported from this post were contracted in more southern latitudes; a conclusion which is strengthened, by the great disparity between the number of intermittents and the number of remittents, and by the occurrence of nearly all the former in the spring of the year. Thus we see that on the St. Mary, in N. Lat. 46° 39′, if the climate do not annihilate the topographi-

* Called by the Voyageurs—'*The Soo.*'
† Medical Statistics of U. S. A.

cal influences producing those diseases, it reduces their effects to a minimum.

From Gros Cap to the Sault, the course of the St. Mary is a little north of east; afterward it turns strongly to the south, and, widening, becomes gradually a shallow western extremity or head of Lake Huron, embracing several islands. The banks of this connecting strait, below Fort Brady, like those above, are clothed with dense forests to the water's edge, and are nearly destitute of inhabitants. To the north is a range of high sandstone hills, which, extending westwardly, touch the lake at the outlet of the St. Mary, and constitute the promontory called Gros Cap. Beyond these hills, in the direction of Hudson Bay, the country is a wilderness, abounding in swamps and small lakes. Although, in following the St. Mary, we are conducted to Lake Huron, it will be most convenient to describe Lake Michigan first.

SECTION II.

BASIN OF LAKE MICHIGAN.

I. General Description. — The position of the northern extremity of Lake Michigan is directly south of the eastern end of Lake Superior, between which there is an unsettled peninsula, bounded on the east by the St. Mary. Michigan is a long but comparatively narrow lake, having its axis nearly in the eighty-seventh meridian, and consequently at right angles with that of Lake Superior. Its northern border reaches the forty-sixth degree of latitude, while its southern — properly its head, — is found about 41° 40′ N. Its area is estimated by Higgins at twenty-two thousand square miles.* Green Bay, which opens into it on the north-west, is computed at two thousand more, making twenty-four thousand, or nearly five-sixths of the area of Lake Superior. Its elevation above the sea is five hundred and seventy-eight feet. Its mean depth is stated at one thousand feet — that of Green Bay at five hundred. Lake Michigan is connected with Lake Huron by the Straits of Mackinac (*Pl. XIV*), in which there is no perceptible current; yet all the water which flows or falls into the former lake, beyond what is absorbed or evaporated, finds its way to the ocean through that channel. Lake Michigan lies, through its whole extent, within the upper and lower, or grey and blue, Silurian limestone. The country near it is not rugged, like that which encompasses Lake Superior; but its banks are, in general, well developed, and the ascent from them to the surrounding water-sheds or summit-levels, is gradual. Its principal rivers are the Menomonee and Fox River, on the north-west, which discharge their waters into Green Bay; and Grand River, the Kalamazoo, and St. Josephs, on the south-east. From the head of Green Bay north-east to the Straits of Mackinac, its shores are but little settled; and further north and north-west, up to the

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* Geological Survey of the State of Michigan.

Lake Superior Basin, in what is called the upper peninsula of Michigan, the country is an uninviting and nearly unbroken wilderness. South of Green Bay, in Wisconsin and Illinois, and round the head of the lake, in Indiana, to a point in Michigan, on the eastern side of the lake, corresponding with the head of that bay, the attractive character of the soil has, within the last twenty years, led to an extensive immigration, and thus rendered the southern half of the Michigan Basin decidedly interesting to the medical topographer. In some places the shores are bold, and composed either of rocks or compact tertiary clay or gravel deposits; but there are many extensive tracts of low ground, some of which are subject to inundation, from the movement of the waters under the influence of winds; while others have been raised above this kind of inundation, by dunes of blown sand from the beach. These spots appear to have been estuaries and small bays, filled up by the alluvion of streams and the moving sands of the lake. Some of them are yet quagmires, with a crust of hardened earth, bound together by the roots of grass, and bearing a resemblance to the new lands in the Delta of the Mississippi.

In a returning voyage from Green Bay to Mackinac, July 28th and 29th, 1842, I found the surface-temperature, between Lat. 45° and 46°, as follows:

Harbor of Navarino, shallow water, - - - - -	78°
The Bay, one hours' run, off the shoals, - - -	74°
" two " " - - - - - -	70°
Lake Michigan, three hours' run, - - - -	68°
" seven " " - - - -	66°
" twelve " " - - - -	58°
" fourteen " " - - - -	59°
" sixteen " " - - - -	62°
" seventeen " " - - - -	63°
Straits of Mackinac, eighteen hours' run, - - -	64°

From these observations it will be seen that the shallow water is warmest. The high temperature of the harbor of Navarino should be ascribed in part to the influence of Fox River, which descends from the south.

II. Green Bay. — The entrance into this bay presents some beautiful islands, composed of the upper Silurian limestone, arranged into mural precipices, which have been whitened by the action of the waves and weather, while their summits are crowned with green trees. The bay is long and narrow, with an axis nearly parallel to that of Lake Michigan. Fox River enters its apex, and presents, on the left or west bank of its estuary, the relinquished and ungarrisoned Fort Howard; on its east, the new villages of Navarino and Astor,— better known, however, under the name of Green Bay. The fort and villages belong properly to one locality, as the estuary which separates them is narrow.

The banks of Green Bay are generally low and densely wooded, with but few settlements. As we approach its head, flat, green savannas show them-

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selves on both sides. According to Doctor Ward,* the head of the bay is skirted with "marshes a mile in width, covered with a luxuriant growth of grass and wild rice, which embrace the mouth of the river, and continue within half a mile of the fort. The water is from six inches to six feet deep on these marshes, which, by the operation of a diurnal flux and reflux of the waters of the bay, are alternately flooded and drained twice every twenty-four hours. Twenty rods back of the fort, another marsh begins, and spreading to the right and left, extends a mile or more in each direction;" that is, to the north-east and south-west: it differs from the other in being partly covered with trees and shrubs, though still abounding in grass. Beyond this is a dry and thickly-wooded plain.

The site of the villages on the opposite side of the estuary, is elevated above the swells of the bay, but abounds, or has abounded, in limited swales or marshes, chiefly dried up since the settlement of the place; leaving deposits of organic matter in their little basins. The plain rises slowly from the river and then declines to the east or north-east, until it terminates at Devil or East River, a stream which approaches the bay nearly parallel with Fox River. Beyond the former the terrace is more elevated, and supports a grove of pine. The neck of land between these rivers, is composed largely of dark sand, colored perhaps by organic matter, and overspread with bowlders of primitive rocks.

I must recur to the swells in the bay, mentioned by Doctor Ward. A regular flux and reflux, twice in the twenty-four hours, would suggest lunar tides; but they are not of that kind; nor, in fact, do they appear with that regularity which his language would suggest. The winds, by changing the level of the waters of the lake and the bay, are the efficient cause of the so-called tides, along the low shores of the latter. These tides are occasionally much greater than common, and depend equally on the south-west and the north-east winds. That currents of air, moving in opposite directions, can produce them, may be understood, by looking on the hydrographical map (*Pl. I*). When the wind is from the north-east, it heaps up the waters of the bay at its head, and when it flows from the south-west, it accumulates the waters of the lake in its northern extremity, whence they flow off into the bay, and raise its level. To the perpetual or frequent submergence of the marshes in this locality, Doctor Forry, in his commentaries on the reports from Fort Howard, ascribes its well-known autumnal salubrity. This, from what I was told in 1842, has always been great.

Thus, Doctor Armstrong, after a residence of seven years in Navarino, declared to me, that intermittent and remittent fevers are almost unknown among its inhabitants; and Mr. Allen and Mr. Horner, two intelligent gentlemen, confirmed his statement. Mr. Ryan, a respectable Indian trader, who had resided there much longer than either, assured me that intermittent fever was unknown, among both the whites and the Indians; but that a mild remittent fever had prevailed in the year 1828. The army returns do not,

* Medical Statistics U. S. A.

however, present so great an exemption; for, through a period of ten years, "the annual ratio of intermittents was six, and of remittents three, per one hundred of mean strength;" *—a rate of prevalence a little greater than at Fort Brady; yet in no degree approaching the ratios of more southern localities, under similar topographical circumstances.

III. Fox River is the outlet of Lake Winnebago. The position of that lake is to the south-east of Green Bay, at the greater elevation of one hundred and sixty feet,† or seven hundred and thirty-eight above the sea. Before Fox River enters the lake from the south-west, it is joined by Wolf River, from the north, which has made its way through several small lakes; in fact, the country around Lake Winnebago abounds in ponds and extensive marshes, from some of which Rock River, already described in the Southern Basin, takes its origin. In ascending Fox River, above its entrance into Lake Winnebago, we arrive at the spot where, having descended from the north, it approaches within a mile of the river Wisconsin; when it turns suddenly to the north-east, and the Wisconsin as suddenly to the south-west. It was over this portage, that the valley of the Mississippi was first entered from the Basin of the Lakes by Marquette. Its elevation above Lake Michigan is two hundred and twenty-three feet — above the sea eight hundred. Its distance from the head of Green Bay is one hundred and twelve miles — from the western shore of Lake Michigan, eighty-one miles.

IV. Fort Winnebago. — This military post stands in N. Lat. 43° 31′, and W. Lon. 89° 28′, on the north-east margin of the isthmus or portage just mentioned, near the right bank of Fox River. The isthmus is a marsh, over which the Wisconsin in high floods pours its waters, to the depth of three feet; when a portion of them flow into Fox River, to find their way to the ocean by the St. Lawrence, instead of the Mississippi. Other swamps exist in this locality. In fact, both sides of each river are bordered with marshy alluvions, of which Doctor Foot* remarks: — "In cutting through the thick vegetable matter on the surface, from two to four feet thick, you come to a stratum of soft mud, generally a foot or two in thickness. In a few places, however, this stratum of mud and water is from eight to ten feet deep. These are known by the name of 'shaking marshes,' and are dangerous to cross with horses. They appear, however, to be filling up, from the same causes that have made the others more solid." Beneath the mud and water is a stratum of fine silicious sand, which is believed by Doctor Foot to be of animalcular origin. He supposes these marshes to have been originally shallow lakes or lagoons, full of aquatic plants, which were then, as now, covered with myriads of animalcules, whose shells were pure silex. As these died annually, each one deposited its particle of silex, until, in the process of time, the lagoon became filled up, having below a stratum of sand, and above an imperfectly organized soil, formed by the annually decaying vegetation.

* Medical Statistics U. S. A.

† Lapham's Wisconsin.

‡ Medical Statistics U. S. A., p. 150.

According to the army returns for ten years, the annual ratio of cases of intermittent fever at this post, is but five per cent.; and of remittent, one and a third per cent.; less, even, than at Fort Howard; notwithstanding the topography of this spot so eminently favors the production of those fevers. It is, moreover, nearly a degree further south; but, at the same time, two hundred and twenty feet higher; which, in reference to the heat of summer, may perhaps compensate for the difference of latitude. It would appear from these statistics that, at Fort Winnebago, a latitude of forty-three degrees and a half, and an elevation of eight hundred feet, greatly control the noxious autumnal influence of extensive bogs and marshes, abounding in organic matter.

V. MILWAUKIE. — The small bay of Milwaukie is a semi-circular indentation on the western coast of Lake Michigan, about the forty-third degree of north latitude. Its length is six miles, and its depth, or projection into the land, three. The shores of this portion of the lake are composed of a post-tertiary clay deposit, from twenty to one hundred feet in hight. The bottom of the bay has been filled up by the alluvion of two small rivers, the Milwaukie and Menomonee, which unite as they enter it. In their common valley, and on the adjacent sloping tertiary plain, to the north, stands the new and rapidly growing town of Milwaukie. After passing through it, the river enters that part of the bay which has been filled up, and winds its way, as a deep and narrow canal, to the lake. The space between the town and the mouth of the river, is an impassable morass, bridged over with a stratum of indurated alluvion, bound together by the roots of the grasses which it nourishes. This crust being penetrated, the soft mud has been sounded to the depth of more than forty feet, without finding bottom.* A part of the bottom on which the town is built, was a wooded swamp, which has been reclaimed. As both the estuary and the marshes of the bay lie to the south of the center of the town, the summer and autumnal exhalations are wafted over it by the winds. Thus, Milwaukie, topographically considered, would be pronounced a sickly town; but such is not the fact. Nevertheless, intermittent and remittent fevers prevail more at this place than at Green Bay, a degree further north, but on the same level; or at Fort Winnebago, half a degree further north, and two hundred feet higher. Still, their prevalence is far less than in some more promising localities in lower latitudes. Thus, Doctor Bean, who had practiced medicine in the latitude of 41°, on the highlands of Illinois, west of Peoria, assured me, that he found much less autumnal fever at his present, than his former residence. In three years, he had seen but five or six cases, all of which were mild; and the number of remittents had been still smaller. This statement, however, excludes some cases in which the disease was contracted elsewhere. Doctor Hewett, who had resided in Milwaukie a longer period of time, had seen rather more of these diseases, especially in the autumns of 1839 and and 1840; yet some seasons had passed away, without presenting scarcely a single case.

* Lapham's Wisconsin.

VI. Racine.—From Milwaukie to Racine, twenty-five miles, a belt of compact and lofty forest, nourished by the influences of the lake, spreads to the distance of two or three miles into the country, beyond which, there are rolling prairies. The site of Racine, in N. Lat. 42° 50′, is a part of this wooded plain, elevated from thirty to fifty feet above the lake. In rainy weather, small pools of water form on many parts of its surface. In digging wells, as Doctor Cary informed me, they pass through a bed of sandy loam, and then through a deposit of gravel, into another of blue clay, with pebbles, when pure but hard water is obtained. At the same level, springs burst out from the banks of Root River, which enters the lake, adjacent to the northern side of the town. The valley of this river, for two or three miles up, is about sixty rods in width, and not subject to inundation. Doctor Cary, who had resided in the place ten years, that is, from the beginning of its settlement, informed me, that for the first two years, there was scarcely a case of autumnal fever; in the next two, a number of cases occurred; and in the following year, 1839, it assumed a mild epidemic character, putting on an intermittent type, and proving fatal in a single instance only. The following year it was again epidemic. In both those years, the mouth of Root River was choked up with sand, and its waters rendered stagnant. In the next three or four years, the cases were very few. Doctor Graves, who had resided eight years in the place, confirmed the statement of Doctor Cary, and added, that every autumn some cases of remittent fever occurred. It appears from these accounts, that, below the latitude of 43°, on the shores of Lake Michigan, a locality presenting but few of the topographical conditions which produce autumnal fever, is much more infested than places further north, in which those conditions exist in a far greater degree; as at Green Bay and Fort Winnebago.

VII. Chicago, the commercial metropolis of Lake Michigan, stands on a low sand-plain, on the western side of the Lake, in N. Lat. 41° 51′, and W. Lon. 87° 35′. The breadth of this flat along the lake is about four miles, whence it runs back ten or twelve miles to the River *Des Plaines*, an elementary branch of the Illinois, described in the last chapter. When the lake stood at a level only twenty feet higher than at present, its waters overspread this bed of alluvion, and a portion of them flowed down the Illinois. At this time it is a savanna, abounding in marshes and low sand-ridges; traversed by the river just mentioned, on the west, and on the east by the north and south forks of Chicago River or Creek; which, flowing nearly parallel with the lake shore, and at a short distance from it, unite within it, and form a short common trunk, which meanders through its center, to the lake. The water in this natural canal is twenty feet in depth, and rises and falls, from the force of winds upon the lake, about two feet; a fluctuation which tends to carry away the filth which would otherwise accumulate on its margins, from the houses on each side, and from the vessels which seek it, as the only harbor of Chicago. From the mouth of this river there is a gradual rise of the plain, to the hight of twenty feet; which may be attained by ascending the south fork of the river, to a spot whence streams sometimes flow to the east and west, on which canoes have passed from the lake into the Illinois River. The canal from Chicago to Peru, mentioned in the last chapter, now passes over that summit-level, which is the lowest between the Gulf of St. Lawrence and the Gulf of Mexico, being, in round numbers, only six hundred feet. Near the lake shore, the winds are constantly blowing a fine dark-colored sand on the margin of the plain, which, south of the town, is raised into low ridgy dunes. The town-plat, from the destruction of the coarse sub-aquatic vegetation, and the tramping of men and animals, is constantly becoming dryer and firmer. Beyond these influences, much of it inclines to marshiness; but as it is not subject to inundation, and is high enough above the Chicago and Des Plaines Rivers, to be drained, by a judicious system of ditching, it will, no doubt, as population increases, be entirely reclaimed.

Fort Dearborn, a vacated military post, stands on a sand-dune, immediately south of the entrance of Chicago River into the lake.

The site of Chicago was occupied in early times by the French, but they never resided on it in large numbers. It was, by the American government, made a military post, and an Indian agency. In the year 1831, the town itself was commenced; and at this time (1848), its population is near twenty thousand. The city is supplied with water from the lake, through a hydrant-system. A growth so rapid indicates its prospective importance, and entitles it to the regard of the medical topographer. Situate on the eastern or leeward margin of a wet or marshy plain of great extent, it would, in a southern climate, be classed with the sickliest localities. Let us inquire, then, into the extent of the countervailing influence of its latitude, which is nearly that of 42°.

According to the returns from Fort Dearborn, for ten years, the annual ratio of its intermittents was twenty-three per cent.,—that of its remittents, four per cent.* The annual ratio at Fort Wood, on the Gulf of Mexico, having Lake Borgne on one side, and a cypress swamp on the other, was, through the same period,—intermittents seventy-six,—remittents twenty-seven. These posts are about twelve degrees apart; and to this difference of latitude we may ascribe the different degrees of autumnal fever, experienced by their respective garrisons through the same period; a difference which may be expressed by saying, that while one hundred men would present but twenty-seven cases of fever at Fort Dearborn, the same number would present one hundred and three cases at Fort Wood. On the other hand, however, we find the proportion at Fort Dearborn greater than at Fort Winnebago and Fort Howard, both lying further north, and the former at an elevation two hundred feet higher.

From Professor Brainard, of Rush Medical College, I received statements, which, when compared with those of the medical gentlemen of Green Bay, Milwaukie, and Racine, indicate a decidedly greater prevalence of autumnal fever in Chicago than in those towns; but he had not met with malignant

* Medical Statistics U. S. A., p. 87.

cases. The accounts given me by Doctor Kimberly were less favorable than those of Professor Brainard. He spoke, particularly, of the year 1835, when the crowd of strangers was great, while the town-plat was still pondy or marshy, and a great deal of wet prairie was broken up with the plow. The statements of Doctors Boon, Davidson, and Brinkerhoff, fully sustained the impression made by the others, and convinced me that the town of Chicago has been more infested with autumnal fever than Fort Dearborn had been; which goes to strengthen the prevalent opinion, that the first exposure of the new soil to the sun, rain, and air, is insalubrious. A part of this up-turning was by the plow, another by the spade in the excavation of the canal. This operation deserves some notice. The canal stretches south-westerly from the town completely across the plain. One of the contractors told me, that, in 1838, he had excavated a mile. The average digging was to the depth of four feet, through a soft black mold, abounding in organic matter. The distance to which this silt was spread out, on each side, was such as to cover a parallelogram of the average width of two hundred and eighty feet, exposed to sun and rain. Doctor Boone had ample opportunities of observing the effect of this proceeding on the health of the people. Nearly all who resided along the line of excavation, sickened with autumnal fever; and almost all the laborers (Irish immigrants) suffered in the same way. Several died with malignant or congestive symptoms.

VIII. Michigan City. This newly-settled town, in the State of Indiana, is situate near the vertex, or southern extremity, of the lake whose name it bears. In passing round the head of the lake from Chicago, it is seen that a belt, three or four miles wide, consists of dunes or hillocks of blown sand, thinly covered with trees. They vary in hight from twenty up to one hundred feet, are of all forms, and give origin to no streams, but inclose ponds of water. The sand is generally white or gray; the soil is very thin, and bears but few herbaceous plants.* Behind this belt, there is, according to Doctor Pulford, formerly of Michigan City, now of Mineral Point, Wisconsin, a broad prairie-marsh, and then, at a little higher level, a tract of wood-land five or six miles wide. To this succeeds a dry and rolling prairie, from ten to twenty miles in width (embracing groves of timber), which extends across the State of Indiana from west to east. Immediately south of this, there is a belt of wood-land, to which succeeds the valley of the Kankakee, with its deep and sluggish waters, bordered on both sides with extensive marshes, having a grassy surface. Thus, the people who inhabit the prairie to the north or leeward, are subjected to influences which, in the latitude of 41° 30′, and at the elevation of six or seven hundred feet, give rise to a great deal of autumnal fever.

Michigan City is situate within the tract here described, on the west side of the mouth of a small stream called Trail Creek, in N. Lat. (about) 41° 47′, on a sandy plain which rises but a few feet above the surface of the lake. In its rear are sand hills and then a marsh. From Doctor Pulford I

* From the late William Harris, Land Surveyor.

learned, that autumnal fever, both intermittent and remittent, prevails here in a decided and often dangerous degree.

IX. LAPORTE.— This town stands within the district just described, ten miles south of Michigan City. The lagging Kankakee, with its vast marshy bottoms, comes within ten miles of it on the south side. The country around the town is level, and composed of diluvium or drift, supporting bowlders, like the whole region adjacent to the lake. It is partitioned, with some equality, between prairies, barrens, or open woods, and dense forests. As Laporte is situate on the summit-level between the St. Lawrence and the Mexican basins, it has no streams larger than rivulets near it; but there are several small lakes, with sandy shores, some of which are so shallow, as to abound in aquatic plants.

According to Doctor Andrew, from whom I have borrowed these facts,* the settlement of Laporte was commenced in 1831, but no autumnal fever occurred until 1838, when it appeared as an epidemic intermittent, and recurred, with diminished violence and extent of invasion, in the two following autumns. Of the reasons why, for the first seven years of its settlement, the town should not have suffered from this fever, and should then have been invaded, I cannot speak.

X. EASTERN COAST OF LAKE MICHIGAN.— The country east of Lake Michigan constitutes a peninsula, which is bounded on the east by the western end of Lake Erie, Detroit River, the River St. Clair, and Lake Huron. Through this peninsula, from north north-east to south south-west, there runs a swell, which rises from two to six hundred feet above the surrounding waters, and supports a countless number of small transparent and permanent lakes; which give origin to rivers that flow to the east and west. Those which take the latter direction offer themselves to our notice in this place. The first and most southern is the St. Joseph, which, originating in the State of Michigan, bends through the north-east corner of Indiana, reënters the state in which it began, and flows into the lake at the town of St. Joseph's. The next in size and southern latitude, is the Kalamazoo, which, originating in the same water-shed, makes its way directly to the lake. The third is Grand River, which, having a similar origin and termination, lies a little further north. The fourth, and last that I shall mention, is the Muskegon, which, from a lacustrine source on the same high lands, enters the lake a little north of the last. These rivers drain the south-west corner of the State of Michigan; which region embraces many interesting towns and settlements; but not having visited it, nor met with any account of its medical topography, I am compelled to dismiss it with this notice.

North of the river Muskegon, up to the vertex of the peninsula at the straits of Mackinac, between the forty-third and the forty-sixth parallels, the rigors of the climate have retarded the settlement of the lake shores, and its medical topography has not been studied; but it is known to abound in small lakes.† On this coast there are two deep narrow bays, called by the

* Western Lancet, Vol. VII, No. 3.

† Michigan Geological Reports.

voyageurs Great and Little Traverse, on which there are missionary stations among the Indians. Their latitude is about 45° 30′. I was told at Mackinac, that the natives at these establishments are sometimes affected with both intermittent and remittent fever; but the number of cases is small.

SECTION V.

BASIN OF LAKE HURON.

I. Outlines. — Lake Huron, as we have already seen, is connected with Lake Superior by the Straits or River called the St. Mary, and with Lake Michigan, by the Straits of Mackinac. It lies south-east of the former, and east north-east of the latter. Its northern border falls between the forty-sixth and forty-seventh parallels, its southern extremity reaches the forty-third. Its area is estimated at twenty thousand four hundred square miles; its elevation above the sea is five hundred and seventy-eight feet; its mean depth one thousand; its greatest depth,— off the mouth of Saginaw Bay,— eighteen hundred or two thousand feet.* A long range of islands, called the Manitoulins, running nearly parallel to its axis, gives to its upper or northern portion, an interior or insular coast. Beyond these islands, there are large bays, of which the most extensive has received the name of Georgian. On that side of the Lake, there are, as yet, no settlements deserving the attention of the medical topographer, until we descend to the country south of the bay just mentioned, between the forty-fourth and forty-fifth degrees of latitude, in Canada West. On the opposite or south-west side of the lake, in the State of Michigan, the country is, likewise, in a great degree unsettled, until we arrive at Saginaw Bay, near the forty-fourth parallel. To the north and north-east, the Huron Basin is bounded by the water-shed of the St. Lawrence and Hudson Basins; to the east and south-east, by the dividing lands between it and Lake Erie and Lake Ontario; to the west, by the highlands which traverse the lower peninsula of Michigan, already noticed. In the south, Lake Huron narrows to a strait, through which its superabundant waters flow off toward Lake Erie. In a voyage from Mackinac to this outlet, on the 9th of August, 1842, when the surface-temperature was probably at its maximum, I found the following variations:

Harbor of Mackinac, - - - - - -	62°.5
Ten or twelve miles out, - - - - -	61°.
Middle portions of the lake, - - - - -	53°.
" " " - - - -	54°.
" " " - - - - -	54°.
In sight of land, Canada shore, - - - -	59°.
" " Michigan shore, - - - -	61°.
Ten miles from Michigan shore, - - - -	61°.
Near the outlet of the lake, - - - - -	63°.

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* Michigan Geological Reports.

Here, as on Lake Michigan, we find the surface-temperature less as the depth of water is greater.

II. MACKINAC. — This is at once the name of an island, a strait, a village, and a fort; as may be seen by inspecting *Pl. XIV;* on which the hight of the island above the water is marked correctly, two hundred and nineteen feet, and the latitudes and longitudes are, approximately, stated at 45° 51′ N., and 85° 5′ W. The island lies a little east of the straits, and therefore belongs to Lake Huron, rather than Lake Michigan. Rising boldly out of the water, it is not fringed with the green marshes, so often seen on the lake margins. Geologically, it is a mass of sub-carboniferous, Devonian or upper Silurian limestone, with the external surface in a state of decay. In some places its escarpments are nearly perpendicular, in others they slope gently down to the lake. On the south side is the harbor, presenting a crescent-indentation, with a beach of limestone pebbles, blanched by the alternate action of the air and water. The latter is so transparent, that the pebbles may be distinctly seen at the depth of many feet. This beach terminates in a low but dry plain, on which stands the village of Mackinac, with the fort in its rear and one hundred and fifty feet above it. The higher — which are the south-eastern — portions of the island, are rocky; but whatever soil has accumulated from the decay of the limestone rocks, is fertile. The opposite end is lower, and has a deeper covering of soil; but the surface is overspread with a countless number of large primitive bowlders. A portion of the gentle slopes of the island is cultivated. Much of the original forest, composed largely of sugar maple and paper birch, is still standing.

The temperature of the water on the lake shore, where shallow, I found, in the month of August, to be 62° Fahrenheit; — where deep, 56°, both at the surface and two hundred feet below. A spring, which bursts out near the bottom of the bold eastern escarpment, had, at the same time, the temperature of 44° Fahrenheit.

From this description it appears, that the conditions which are held to be necessary to the generation of autumnal fever, are at their *minimum* on this island; and, when we connect this fact with its latitude, — nearly 46°, — and its altitude above the sea, — from six to eight hundred feet, — we are prepared to find it almost exempt from that disease; and such, from the testimony of its inhabitants, is the fact; especially in reference to the intermittent form, which, I was assured by many respectable persons, never originated among the people of the town, and would cease spontaneously in those who returned or came with it from other places. Doctor Rankin, however, who had resided four years in the village, had met, in autumn, with a few remittents, which tended to a continued form. But we must not overlook the army returns, from the post which has long been maintained on this island.

According to those returns,* the ratio of remittent fever is one per cent. per

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* Medical Statistics U. S. A., p. 74.

PL. XIV.

Litho: by A. Wocher. Face 346. C. A. Fuller U.S.C. Engr.

annum; of intermittents, eight. The latter ratio seems to invalidate the assertion, that intermittent fever is nearly unknown here, and requires to be examined. During the period embraced in the returns, there were sixty-five cases reported, of which seven were in the first quarter of the calendar year, thirty-one in the second, thirteen in the third, and fourteen in the fourth. Now, in the climate of that post, no new case can be generated within the first and second quarters, and consequently, of the sixty-five cases, thirty-eight must be regarded as relapses, or as vernal intermittents, depending on a morbid impression made on the system the preceding autumn. Still further, of the fourteen cases in the fourth quarter, we may suppose a proportion, equal to that of the first quarter, to be of the same kind; for the cause of the disease could not be in existence in the months of November and December; we may, then, subtract five from the returns for that quarter, and place them with those for winter and spring, raising that column to forty-three, and, consequently, leaving but twenty-two cases of summer intermittent, for the whole period. It cannot be said that the vernal intermittents were of those who had contracted the disease on the island in the preceding summers and autumns, for a part only of those who suffer in the latter seasons, relapse in the spring; but here the number of vernal cases was greater than the whole number of autumnal.

It seems to result, then, from what has been said, that at least two-thirds of the cases at Fort Mackinac must have been contracted elsewhere; reducing the number of (possibly) original cases, to less than three per cent., with a probability that even these might have resulted from the previous action of the remote cause at some more southern and sickly post. Doctor Forry, the editor of the Army Medical Statistics, thinks it difficult to explain why the second quarter of the year presented twice as many cases as the third; but what has been said, perhaps accounts for it; while it reconciles the garrison returns with the popular opinion, that intermittent fever is not among the endemic diseases of the island.

III. Summer Voyages on Upper Lakes, with a Residence at Mackinac, for Invalids. — The three great reservoirs of clear and cold water — Lakes Huron, Michigan, and Superior, with the Island of Mackinac in their hydrographical center — offer a delightful hot-weather asylum to all invalids, who need an escape from crowded cities, paludal exhalations, sultry climates, and officious medication. Lake Erie lies too far south, and is bordered with too many swamps, to be included in the salutiferous group. The voyage from Buffalo, Cleveland, or Sandusky, on that lake, or from Chicago or Milwaukie, on Lake Michigan, may afford, should the water be agitated, all the benefits of sea-sickness, without its tedious prolongation. On reaching Mackinac, an agreeable change of climate is at once experienced; and the bodily feeling is hightened, by the emotions which the evidence and consciousness of having retreated upon an island, raise in the mind of one who has not before enjoyed the novelty of an insular life. To his jaded sensibilities, all around him is fresh and refreshing; a feeling of security comes over him, and when, from the rocky battlements of Fort Mackinac, he looks down upon the surrounding waters, they seem a moat of defense against the host of annoyances from which he had sought a refuge. Thus a curative state of mind begins to act on his body, from the moment of his landing; and, if he be a person of intelligence and taste, this salutary mental excitement will not soon die away; for the historic associations, not less than the scenery of this island, are well fitted to maintain it.

The first white men who dwelt on Mackinac, and the surrounding coasts, were the French ecclesiastics and fur-traders. In 1763, the whole passed, with Canada, to the jurisdiction of Great Britain; by whom, in 1796, it was surrendered to the United States. In 1812, it was conquered by that power, and restored at the close of the war. From the summit of the island, the eye rests upon a number of spots consecrated to military history. But the natural scenery is still better fitted to make the invalid forget his ailments. Several agreeable and exciting boat voyages may be made to the neighboring coasts, from each of which a new aspect may be had; and the island itself, although but nine miles in circuit, affords opportunities for a great variety of rambling on foot. In these excursions he may ascend to the apex of the island, once the site of a fort. From this summit, elevated far above all that surrounds it, the panorama is such as would justify the epithet to Mackinac—Queen of the Isles. To the west, are the indented shores of the upper peninsula of Michigan; to the south, those of the lower, presenting, in the interior, a distant and smoky line of elevated table-land; up the straits, green islets may be seen peeping above the waters; directly in front of the harbor, Round Island forms a beautiful foreground; while the larger *Bois Blanc*, with its light-house, stretches off to the east; and to the north are other islands, at varying distances, which complete the archipelago.

When the observer directs his eye upon the waters more than the land, and the day is fair, with moderate wind, he finds the surface as variable in its tints, as if clothed in a robe of changeable silk. Green and blue are the governing hues, but they flow into each other with such facility and frequency, that while still contemplating a particular spot, it seems, as if by magic, transformed into another; but these mid-day beauties vanish before those of the setting sun, when the boundless horizon of lake and land seems girt around with a fiery zone of clouds, and the brilliant drapery of the skies paints itself upon the surface of the waters. Brief as they are beautiful, these evening glories, like spirits of the air, quickly pass away; and the gray mantle of night warns the beholder to depart for the village, while he may yet make his way along a narrow and rocky path, beset with tufts of prickly juniper. Having refreshed himself for an hour, he may stroll out upon the beach, and listen to the serenade of the waters. Wave after wave will break at his feet, over the white pebbles, and return as limpid as it came. Up the straits, he will see the evening star dancing on the ruffled surface, and the loose sails of the lagging schooner flapping in the fitful land-breeze; while the Milky Way—DEATH'S PATH of the red man—will dimly appear in the waters before him. Behind, in the street, a lively group of Canadian French, of every shade of color between white and red, will gossip and shrug their shoulders; on one side, should the Indians, who still inhabit the shores of Lake Michigan, be on a visit to the island, he will hear the uproar of a lodge of drunken Chippewas, with the screams of women and children, and the cackling of frightened hens; on the other, will see the sober and listless Ottowa, sitting in silent vacancy of thought, on his upturned birch canoe, his wife within the tent, spreading cypress bark and flag mats upon the gravel, as lodgings for the night; while half a dozen children loll or play about the door, and as many half-starved dogs curl up among them. Surrounded by such scenes, the traveler begins to realize that he is a stranger; when, suddenly, a new phenomenon appears, and fixes the conviction. Every object becomes more visible; and, raising his eyes, he beholds the heavens illuminated with an aurora borealis, where he reads in fantastic characters of strange and eccentric light, that he is, indeed, a sojourner in a strange land, and has wandered far from his friends and home, in the sunny regions of the south.*

While the valetudinarian, during the summer months, makes the island of Mackinac his home, he may enjoy several interesting steamboat voyages. At any time, he can descend to Detroit and Niagara; or, passing through the straits of Mackinac, visit Chicago, Racine, and Milwaukie, on the western coast of Lake Michigan. Opportunities will likewise be presented, to ascend the St. Mary to the *Sault*, where he will find much to interest him; and whence he may proceed, in a fur-trading skiff, or a bark canoe, to Gros Cap, at the efflux of the river from Lake Superior. Finally, he may have it in his power to embark on that lake, and visit the copper hills of the mineral region near its southern shore; the climate of which is represented as highly invigorating; while the novelty and wildness of the scenery will act with salutary influence on his imagination and feelings.

Those who are prone to consumption, might, perhaps, experience some injury from the humidity of this lacustrine region; to hypochondriacs, dyspeptics, chlorotics, and all who have their constitutions broken down by autumnal fever, it must, however, prove eminently restorative.

IV. DRUMMOND'S ISLAND.—In leaving Mackinac, we shall proceed down Lake Huron, on its northern and eastern shore, which, it will be recollected, lies in Canada West. The large island with which we begin, called Drummond's Island, is the most western of the Manitoulin Chain, and lies immediately east of the mouth of St. Mary's River, in latitude 46°. The British once had a fort upon it, near which there were extensive marshy shores, but autumnal fever was almost, if not entirely, unknown.†

V. PENETANGUISHINE.—This village, of one hundred and twenty inhabitants, chiefly French and Indian half-breeds, is the seat of a small naval and military establishment.‡ It stands on the southern shore of Georgian Bay, in N. Lat. about 44° 45′, at the base of a long sandy ridge two or three

* The Northern Lakes a Summer Residence for Invalids of the South. By Daniel Drake, M.D.: 1842.

† Tulloch's Statistical Reports of the British Army.

‡ Smith's Canadian Gazetteer.

hundred feet high, which projects into the bay. At the head of the bay, and for several miles south-east, there are low swampy grounds, between which and the barracks, however, a hill intervenes. The surrounding country is undulating or hilly, and generally covered with woods. In 1828, the troops were transferred to this post from Drummond's Island. It has proved to be as free from autumnal fever as that island. That fever, in fact, is nearly unknown.*

VI. COUNTRY AROUND GEORGIAN BAY.—On the north and north-east of Georgian Bay, to the water-shed between the St. Lawrence and Hudson Basins, the country is wild and dreary, abounds in small lakes, and remains unsettled. The region around the bottom or southern extremity of the bay, in the rear of Penetanguishine, extending to within forty miles of the head of Lake Ontario, includes the large and beautiful Lake Simcoe; which, by a descent of one hundred and seventy feet, and a circuitous route to the north, discharges its superfluous waters into Georgian Bay, through the Severn River. The region to the south-west of this river, between the bay and lake, as well as that drained by all the rivers which fall into both, is covered with excellent soil, and has a considerable, though scattered, population.† The surface is generally wet and in many places marshy, but in the latitude of 44° or 45°, such a condition produces but little autumnal fever. Its medical history, however, has not been written.

VII. LOWER EASTERN SHORE OF LAKE HURON.—Most of the cape between Georgian Bay and Lake Huron, is unsettled Indian country; and it is not until we descend below the latitude of 44°, that we come into a region of interest to the medical etiologist. There, we reach the Huron District, which extends nearly to the southern extremity of the lake, and has a considerable population, composed almost entirely of immigrants from Europe. The district includes a swamp of vast extent. The principal town of the district is *Goderich*, on the shore of Lake Huron, at the mouth of Maitland River, about N. Lat. 43° 45′. It stands on a dry surface, one hundred feet above the lake.‡ According to Doctor Stratton,‖ autumnal fever is rarely seen at this place. Of the medical topography of the district generally, and the prevalence of fever in autumn, I can say nothing further.

VIII. WESTERN SHORE OF LAKE HURON, AROUND AND SOUTH OF SAGINAW BAY.—This bay projects to the south-west, from the western or Michigan side of the lake. Its extreme point, in Saginaw county, receives the waters of Saginaw River, which originates within the coal basin which occupies the center of the lower or southern peninsula of the State of Michigan. This is the most considerable tributary of the western side of Lake Huron. There are considerable settlements within this basin, but nothing has been published on its medical topography. There was a military post at the head of the estuary of Saginaw River, at which, as Doctor Pitcher, now of Detroit, has informed me, autumnal fever prevailed, and sometimes assumed a malignant character. The latitude of the post was about 43° 20′ N. From

* Tulloch.
† Smith's Canadian Gazetteer.
‡ Smith's Canadian Gazetteer.
‖ Edinburgh Medical and Surgical Journal, No. 164.

Point aux Barques, immediately below Saginaw Bay, down to the terminating extremity of the lake, the coast is nearly straight, with but few indentations, and presents low cliffs of sandstone, emerging from under the coal basin of the interior of Michigan; while the coast above the bay shows cliffs of upper Silurian limestone, which have risen from beneath the sandstone. This lower coast, and the country in its rear, are but sparsely peopled, and I know nothing of its special medical topography or autumnal diseases.

SECTION VI.

STRAITS BETWEEN LAKE HURON AND LAKE ERIE: LAKE ST. CLAIR.

I. The Straits.—These straits have received two names. The portion which extends from Huron to the little Lake St. Clair, is called St. Clair River; that which extends from the southern side of that small body of water, to the west end of Lake Erie, is the well-known Detroit River. The fall in the two is fourteen feet. Both the upper and lower portions are bounded by banks of post-tertiary or diluvial clay, supporting heavy forests, wherever settlements have not been made. The current of this broad and deep natural canal, except where the water issues from Lake Huron, is gentle; its width is from one to two miles. St. Clair River is about forty miles long — Detroit River, twenty-three or twenty-four. The banks of the upper part of St. Clair River are well-developed; but as it approaches Lake St. Clair they sink, and its shores become more or less marshy. The upper part of Detroit River has banks sufficiently high; but as we descend, wet or swampy grass flats appear on each side of the river.

II. The Lake.— This little intermediate sheet of water has a mean length and breadth of twenty and eighteen miles; an area of three hundred and sixty square miles; a mean depth of twenty feet; and an elevation of five hundred and seventy feet above the sea,—being in that respect intermediate between Lakes Erie and Huron. The silt thrown into St. Clair River by its tributaries, is deposited at the head of Lake St. Clair, where alluvial islands are continually forming. St. Clair River, in fact, has a delta, that is regularly advancing into the lake,* which, from this source and the rivers which open into it laterally, will ultimately be converted into a marsh, with a river running through it. Much of the land around it is low and swampy; and there are, also, large savannas, so dry as to form natural grazing lands, and even to admit of cultivation, which are inundated by the periodical rises to which the lakes are subject.† In the month of August, I found the surface-temperature of this shallow lake, to be from 66° to 71°, according to its depth. In winter it is entirely bridged over with thick and firm ice, which has become an article of exportation to Cincinnati.

III. Head of the Straits: Fort Gratiot: Port Huron: Port Sarnia. — The efflux of St. Clair Strait or River from Lake Huron, is in a loca-

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* Michigan Geological Reports. † Smith's Canadian Gazetteer.

lity of some interest to the medical historian. Its latitude is 43° N., its longitude 82° 10′ W. The hight of the banks may be taken at six hundred feet above the sea. Within this locality, there is the *embouchure* of Black River, with Fort Gratiot and the town of Port Huron, on the Michigan side, and the town of Port Sarnia, with an Indian village, on the Canada side. Fort Gratiot stands on a sand-dune, very near the point of exit of the waters of the lake, and Port Huron on the same dune, a mile below, at the mouth of Black River.

The sources of this river are in tamarack swamps, not far from the western shore of Lake Huron, nearly parallel to which shore it flows on until within a few miles west of Port Huron, when it turns to the eastward and joins St. Clair River at that town. Its water, like that of many other streams having a similar origin, has the color of ink liberally diluted, which seems to be produced, either by some exclusively vegetable coloring-matter of the swamps, or by the tanno-gallate of iron, formed by the union of the appropriate acid (supplied by the tamarack pine) with the metal, in which the soil of that part of Michigan abounds. Black River, as it approaches the St. Clair, lies immediately to the west or windward of Fort Gratiot and Port Huron, at a distance varying from a few hundred yards to a mile, without any intervening hills, while its bottoms are broad and swampy, and its own current checked by a mill-dam near its mouth. Between the two rivers, is the sand-dune of which I have spoken, with its little pools, or wet basins, in which the recrements of plants have been decomposed into soil. The western or right bank of the river is higher, and consists of compact post-tertiary clay, with pebbles. Opposite the fort and village, the St. Clair is fringed with a narrow belt of low alluvial bottom, on which rain-water stands in little ponds, or forms smalls marshes, and over which the river flows in the periodical rises of the lake.

Fort Gratiot. — The returns from Fort Gratiot* show a decided prevalence of intermittent fevers; the annual ratio being seventy-two per cent; that of remittent fever is, however, only three per cent. When we compare the relative prevalence of these two forms of fever at this post, with their prevalence at Fort Crawford, in the same latitude, on the banks of the Mississippi, we find that, while intermittent fever is more prevalent here, remittent fever is more prevalent there. Here, the latter makes but three or four per cent. of all the cases of autumnal fever; there, it makes fourteen per cent., and is, therefore, four times as prevalent, compared with the intermittent form. When we bring Fort Snelling, on the Mississippi, in N. Lat. 44° 53′, into this comparison, the conclusion is strengthened; for, at that post remittents make thirty-three per cent. of the whole. These facts are instructive. A long river-beach low-water marsh lies to the windward of Fort Crawford, and the swampy mouth of the St. Peter's in the same direction from Fort Snelling; but the amount of watery surface around those spots, in autumn, is small, compared with that around Fort Gratiot, which has the

* Medical Statistics of United States Army.

lake on its north, the St. Clair on its east, and Black River, with a dam and pond, on its south and west. The atmospheric humidity of this little peninsula is, therefore, very great, compared with the sites of Fort Crawford and Fort Snelling, and to this meteorological condition, we must I think, ascribe its greater proportion of intermittents compared with remittents. Doctor Forry, the ingenious editor of our army statistics, has compared this post with Mackinac, and ascribed the difference in autumnal fever to topographical causes. It results, however, in part from the higher latitude and elevation of Fort Mackinac; as the comparative absence of that fever at Fort Howard and Fort Winnebago, places south of Mackinac, but north of Gratiot, and with topographical conditions similar to those of the last, sufficiently proves. The forty-third parallel, with an elevation of six hundred feet above the sea, is, in fact, very near the highest latitude, at which, from the Mississippi eastwardly to St. Clair River, autumnal fever appears in an *epidemic* form. Beyond that degree, it rapidly diminishes, and in the forty-sixth is nearly unknown as an original disease. At a lower level, the line of epidemic prevalence will, of course, be found farther north.

Port Huron. — To return to our present locality, I may state, that the people of the village of Port Huron, as I learned from the resident physician, Doctor Noble, and from Doctor Southgate, the post surgeon, are as subject to autumnal fever as the troops; and the settlers on the banks of the St. Clair, below the town, likewise suffer from the same disease.

Port Sarnia. — This Canadian village stands on the east bank of St. Clair River, opposite Port Huron. Above it, the low cape, Point Edwards, narrows the outlet of the lake to half the width of the river, in front of Port Sarnia, and establishes, opposite and above that village, a miniature bay of shallow water, abounding in aquatic grasses. The site of the town, is a sufficiently elevated terrace of post-tertiary clay and gravel, or hard pan, identical in character with that immediately below the mouth of Black River. This plain is overspread with lofty forest trees. On the river bank, south of the village, there is a permanent settlement of Chippewa Indians. The inhabitants of Sarnia, and its vicinity, are subject to autumnal fever;* but whether more or less so than those of Port Huron, I cannot say.

VI. Adjoining parts of Canada. — The western beak or peninsula of Upper Canada, in which Port Sarnia lies, is bounded on the north by the lower end of Lake Huron, on the south by Lake Erie, and on the west by St. Clair River, Lake St. Clair, and Detroit River. In the civil divisions of Canada, it constitutes the Western district. Its principal river is the Thames, which, traversing it from east to west, opens into Lake St. Clair. The next in size is Bear Creek or Sydenham River, composed of two forks, the north and the east, which drain the country, in the rear of Port Sarnia, and throw their united waters into the Delta of St. Clair River.

The Thames, which is one hundred and fifty miles in length, originates in Brook and Huron districts, where, by its southern branch, it interlocks with

* From W. Jones, Esq., Assistant Superintendent Indian Department.

tributaries of Grand River, whose waters fall into the eastern end of Lake Erie. From these origins, the Thames traverses London district, and, lastly, the Western district, in which it joins Lake St. Clair. The town of London is situate at the junction of its two principal branches. The basins of the Thames and the Sydenham, comprehend the best portions of Canada West. In the interior, the surface is rolling, in some places hilly; — but there are also tracts of swamp, and the streams have alluvial bottoms, many of which are subject to inundation. Advancing toward Lake St. Clair, the country becomes more level, the wet savannas multiply, and the low river-bottoms acquire greater breadth. The mouth of the Thames is in N. Lat. 42° 20′, — its northern sources in 43° 20′. Every part of the region drained by this river, and also of that drained by the Sydenham, is liable to autumnal fever; but the lower or western, much more than the interior, which is dryer and a little farther north. The insalubrity of many localities in the Western district has retarded their settlement. I cannot say whether the old settlements of Canadian French, on the banks of the Thames, suffer as much as the recent immigrants from Europe and the United States.*

VII. SANDWICH. — This village stands on the east bank of Detroit River, nine miles below Lake St. Clair, and three below the city of Detroit. It is one of the oldest French settlements in Canada West, and many of its inhabitants are still of that race. It has, at times, been the seat of a military post. It is built on a sloping gravelly bank; but there are marshes around it, over the surface of which Doctor Stratton has often seen, in the morning and evening, a thin stratum of dark-colored air, perceiving, at the same time, an offensive smell, and experiencing, at the latter hour, a peculiar sensation of heat; an observation made by others beside himself. The inhabitants are subject to autumnal fever; and during the time that two companies of troops were in barracks there, half of them were often ill, at once, with that disease.

Windsor, a small village, two miles north of Sandwich, is situate on a high bank of Detroit River, and enjoys an exemption from creeks and marshes. A body of colonial militia stationed there, remained healthy in summer and autumn.†

VIII. AMHERSTBURG AND MALDEN. — The extreme south-west point of Canada West, is the township of Malden, at the junction of Detroit River with Lake Erie. It comprehends the town of Amherstburg, and a permanent military post called Fort Malden. It was settled long since by Canadian French, but contains many English, Scotch, Irish, and American immigrants, with a large negro population, from the United States. Its soil is extremely fertile.‡

Amherstburg rests on Detroit River, about a mile from the lake, and *Fort*

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* Smith's Canadian Gazetteer. — Doctor Stratton, in Ed. Med. and Surg. Journal. — Martin's History of the British Colonies.

† Stratton, Ed. Medical and Surgical Journal, No. 147.

‡ Smith's Canadian Gazetteer.

Malden stands half a mile above the town, in N. Lat. 42° 36′, and W. Lon. 82° 56′. About half the surrounding country is in woods. The vicinity of the town is flat, and there are several extensive marshes; there is, also, a creek hard by, the banks of which are overflowed by freshets in Detroit River, and much of the water left to evaporate. Around the fort there is a ditch, containing stagnant water. The troops in Fort Malden have always been afflicted with autumnal fever, both intermittent and remittent; and, throughout the summer and autumn, most families of the village have, successively, a member down with it. In the winter of 1839 and 1840, Doctor Stratton saw a *few* cases (*quere*, relapses?) before the 17th of February, when there came a thaw, which floated off the ice that had buried up the muddy banks of Detroit River, and "the next morning several persons, living in houses along the bank, were attacked with ague." *

IX. DETROIT. — There is no considerable town or river between Port Huron and the city of Detroit, standing on the right or Michigan side of the straits. Much of the bank around and below Lake St. Clair, has long been settled by Canadian French, and, in its elevation above the surface of the river, as well as the style of domestic and agricultural improvement, it resembles the '*Coast*' in Louisiana.

Detroit is built in N. Lat. 42° 20′, and W. Lon. 82° 58′, about six miles below Lake St. Clair, on a post-tertiary clay plain, which stretches many miles into the interior. Its elevation is from twenty to thirty feet above the surface of the river. To its north-east, at the distance of a mile, a small stream, named Bloody Run, and then another, called Conner's Creek, enter Detroit River; above which, at the exit of the river from Lake St. Clair, there is an extensive marsh. At the distance of three miles below the city, opposite Sandwich, the bluff banks recede, and green marshes are developed on both sides of the river. Through these marshes, at the distance of five miles from Detroit, the small river Rouge, a foul and sluggish stream, with swampy alluvions, makes its way from the west to Detroit River. The level country back of the city abounds in marshes, swales, and peat bogs; but the suburbs are not infested. The ground on which the city stands, however, is too level to permit good drainage, and too clayey to favor percolation; it is therefore, in spring and autumn, so wet that board pavements are preferred to brick. Well-water can be obtained by digging into the argillaceous plain, which, at the depth of a hundred feet or more, rests on the upper Silurian limestone. The city, however, is supplied with river-water by a steam engine and pump.

The condition of the opposite bank, on which stands the hamlet of Windsor, has been already mentioned. From this sketch it appears, that the ancient metropolis of the upper lakes, is neither greatly exposed to, nor exempt from, those topographical circumstances, which give rise to autumnal fever; the prevalence of which harmonizes with the topography. Of the degree in

* Ed. Medical and Surgical Journal, No. 147. — Tulloch's Statistics of the British Army. — Smith's Canadian Gazetteer.

which that fever prevailed among the French, who, in 1701, began the settlement of Detroit, under the name of Fort Pontchartrain, we have no record. At this time, the site of the city and its environs must be regarded as a surface long broken up and exposed to the action of the sun and rains; which, it is well known, at last destroys some of the topographical causes of autumnal fever. Still, as I learned from Doctor Pitcher and Doctor Potter, intermittent and remittent fevers occur every autumn, both in the city and its suburbs, and occasionally assume a malignant type.

X. Basins of the Rouge and Huron Rivers.—These small rivers, of which the latter is the larger, drain the country in the rear of Detroit. The Rouge, as we have already seen, joins the straits five miles below the city; the Huron pours its waters into the north-west corner of Lake Erie, a few miles below Amherstburg, on the opposite side of the estuary of Detroit River. The general course of both the Rouge and Huron is to the south-east, and thus their middle and upper waters lie to the west of the city of Detroit. Their sources are in several small lakes, at an elevation of about one hundred and fifty feet above the Detroit plain, from which they descend with a rapid current, to traverse the broad and flat surface of Wayne county, which extends from Lake St. Clair to Lake Erie. Within this tract, their currents, and those of all the smaller streams, are sluggish. About one-third of Wayne county is composed of undulating oak plains, more or less sandy, and interspersed with wet grassy prairies; while two-thirds consist of flat heavily timbered lands, abounding in marshes. From Lake St. Clair down to Huron River, at the distance of a few miles back from Detroit River, there extends a slip, three or four miles wide, which is depressed below the general level, and is either wet or swampy. South of the Rouge, between it and the Huron, this belt presents extensive wet prairies. The rivers and smaller streams which traverse it, having but little current, overspread it in their freshets to a large extent. This tract of low grassy surface, in fact widens toward the mouths of those rivers. The region we are now describing, is composed of a deep upper stratum of post-tertiary clay, covered with rich soil, and resting on Silurian limestone; which rock, as we advance into the interior, shows itself, here and there, through its argillaceous covering.*

Township of Plymouth.—Doctor Sprague † has written a paper on the topography and diseases of the north-west township of Wayne county, watered by the upper streams of the west branch of the river Rouge. The north half of the township is hilly, and covered with forest; the other half level, and partly timbered. Mill-ponds abound, and one of them, with its vicinity, is thus described: "The pond is located in a valley, which is formed by the rising of two banks to the hight of fifty or sixty feet. The greatest distance between them is forty or fifty rods, most of which is occupied by the pond, which contains a great deal of decaying vegetable matter, both

* Michigan Géological Reports.—Gazetteer of the State of Michigan.
† Western Lancet, Vol. IV, No. 7.

ligneous and herbaceous. From the western bank, another terrace, densely covered with trees, arises." Between the first bank on that side and the pond, upon a small area, rising but ten feet above the latter, there resided seven families, into one of which, in the month of August, 1843, Doctor Sprague was called to treat a case of simple intermittent, and for the next five weeks, generally had from eight to twelve patients in this little community. Meanwhile the health of the surrounding country was good, save a family here and there, residing near some other pond. In the ensuing summer, the dysentery prevailed in many parts of the township; but, with the exception of a single case, passed by the pond settlement; which, however, suffered again from autumnal fever. As a general fact, Doctor Sprague remarked, that intermittent and remittent fevers prevail, for five or six weeks every year, in and around the ponds and marshes of this part of Michigan. The latitude of this region is 42° 30′ N.

From *Dearbornville*, where the river Rouge receives the waters of its west branch, down to Detroit River, its current lags, and its banks are low and wet. It was originally settled by Canadian French, who have, as the late scientific and indefatigable Doctor Houghton informed me, at all times suffered severely from autumnal fever. As this shallow valley lies from five to ten miles to the windward of Detroit, without any intervening hill or extensive forest, it may be one source of the fevers which occur in that city.

In making a railroad trip from Detroit to Ann Arbor, I observed that the surface of the country, out to the Rouge near Dearbornville — a distance of ten miles — was flat, and in many places marshy, with heavy forests. The Rouge, where the road crosses, was sluggish, with a foul aspect.

Ann Arbor is built on Huron River, forty miles west of Detroit. The larger and better part of the town is on the western bank, which presents two terraces, a lower and a higher. On each side of the stream, there is a narrow slip of alluvial bottom, liable to inundation when the river is high. The University of Michigan stands half a mile west of the river, on the upper terrace. From Doctor Denton, who had resided seventeen years at this place, I learned that its inhabitants had suffered from autumnal fever, in common with those near the river, above and below the town. The same gentleman had also observed that the people who reside on the left-hand or leeward bank of the river, suffer more than those of the opposite or southwest side. By his narrative of symptoms, I discovered that cases as malignant or congestive as any in the south, occasionally occur.

First Plowings.—Doctor Denton, and Doctor Houghton, the naturalist of the University, assured me, that they had seen many examples of the influence of the first plowing up of new lands, both prairie and forest, in the production of autumnal fever. Even the breaking up of dry gravelly soils had been followed by fever.

CHAPTER XIII.

THE EASTERN OR ST. LAWRENCE BASIN, CONTINUED.

BASIN OF LAKE ERIE.

Erie, the last and most southern of the Upper Lakes, receives, through Detroit River, the overflowings of Lakes Superior, Michigan, and Huron, which enter its western extremity, and are discharged, with its own superabundant waters, from its eastern, by the Niagara River. Their ingress is just above the forty-second parallel — their egress, a little below the forty-third; the distance between those points being about four degrees of longitude, that is, from the seventy-ninth to the eighty-third. Lake Erie, like Lake Michigan, is a long narrow body of water, with an axis running nearly east north-east and west south-west. Its form is that of a compressed oval, indented on the north side, and elongated to a beak at its eastern extremity. Its mean length is two hundred and forty miles; its mean breadth, forty or fifty miles; its mean depth, eighty to ninety feet; and its elevation above the sea five hundred and sixty-four or sixty-five feet.* The shallowness of this lake, compared with those above it, constitutes, perhaps, its greatest point of difference from them; and is such, that strong winds agitate it to the bottom, and render its waters more or less turbid, according to their depth. On its north or Canadian side, the basin of Lake Erie is of such limited extent, that all the tributaries it supplies, except Grand River, which enters near the eastern extremity of the lake, are of insignificant size. This results from the manner in which it is overlapped at each end, respectively, by Lake Huron and Lake Ontario, in their approximation to each other. On the southern side, the basin is much wider, and watered by a far greater number of considerable rivers; of which the Raisin, Maumee, Sandusky, Huron, Black, Cuyahoga, and Grand, counting from west to east, are the most important. In beginning with the River Raisin, we shall preserve the continuity of description from the region west of Detroit River, till we complete the southern portions of the Erie Basin.

* Ohio Geological Report.

SECTION I.

BASIN OF THE RIVER RAISIN.

I. The mouth of this river is near the middle of the western end of Lake Erie, about fifteen miles south of Huron River, described in the last Chapter. The western portion of the district lying between these rivers, presents a rolling surface, with an elevation of a hundred feet or more above the lake, from which the streams descend with a rapid current; but when they reach the plain, but little raised above the lake, they form estuaries, into which its waters are driven by the winds. This belt, extending from the Huron to the Raisin, and including both, abounds in green marshes, relieved by low sand-dunes, which, at the present elevation of the lake, may be regarded as irreclaimable. The subjacent rock is Silurian limestone, which, after having emerged from under the coal basins of the south, is found here dipping to the north, to pass under the coal measures of the State of Michigan.

The sources of the River Raisin interlock with those of Grand River and the Kalamazoo, which empty into Lake Michigan. Its course is extremely serpentine, and its current at the same time swift, until it approaches the lake.

II. Monroe stands chiefly on the right or southern bank of this river, three miles, in a straight line, from the lake, but six miles, following the stream, as it meanders among the low alluvial islands of its little delta; on which the waters of the lake are driven, by every east wind, and every 'ground swell.' The approach to the mouth of this river by the lake, is over exceedingly shoal water, and the road from the dock passes, for a mile, through a flat, covered with aquatic grasses. It then traverses low sand ridges, to Monroe, which stands on a dry and level sand-dune. The river here has rapids, that begin above and continue to a point just below the town; the water descending over Silurian limestone rocks. The foot of these rapids is the head of the broad estuary of the river. It is doubtless well for Monroe, that this estuary and its marshy borders lie to the east or leeward; but the almost daily effusions of the lake are regarded by the physicians of the town, Doctors Landon, Conant, and Southworth, as limiting its insalubrity. Thus, they affirm that the people of Monroe, and those living between it and the lake, are but little affected with autumnal fever, compared with the inhabitants immediately above the falls, and westward of them, in the interior; where the tributaries of the Raisin are generally sluggish, and marshes more or less abound. In that region, as those gentlemen stated from personal observation, there is a great deal of autumnal fever, including many malignant cases, known among the people as 'chill-fevers.' Both Doctor Landon and Doctor Conant assured me, that they had repeatedly seen the breaking up of new soils in that quarter occasion fever.

Monroe stands near the site of an old Canadian-French village, settled as early as the year 1776, and known first as the 'River Raisin settlement,' and then as 'French Town'—the spot where the sad and memorable 'massacre of the River Raisin' took place. Doctor Conant, who came to it in the year 1820, found it as healthy then as at the time of my visit, in 1842; but the surrounding country was more infested, at that time, with autumnal fever, than in latter years.

It has been said, that people who live near the falls and rapids of our rivers are peculiarly liable to autumnal fever; but this is certainly not the case at Monroe.

III. The lake shore, south of the River Raisin, for the distance of twenty miles, resembles that already described, consisting everywhere of broad watery savannas. The road to the south runs at the distance of three or four miles from the lake, through a forest growing on a post-tertiary clay plain, with occasional flat ridges of blown sand.

SECTION II.

BASIN OF THE MAUMEE RIVER AND BAY.

I. The River. — The Maumee River, formerly called the Miami of the Lake, is one of the largest tributaries of Lake Erie; which it enters by Maumee Bay, about twenty miles south of the river Raisin, in Lat. 41° 40′ N. The Maumee is formed by two rivers: — the St. Joseph, which has its origin in the State of Michigan, where it interlocks with the head-waters of the St. Joseph of Lake Michigan, and whence it runs nearly south-west, until it joins the St. Mary, the sources of which interlock with those of the Great Miami and Wabash — tributaries of the Ohio River. This spot, in Lat. about 40° 20′ N., is the most southern extension of the St. Lawrence or Eastern Basin. Uniting in the State of Indiana, these rivers make the Maumee, which descends to Lake Erie in a direction nearly north-east. On its way, the Auglaize, equal in size to either of its elementary branches, joins it on the right or south-east side. The Wabash and Erie canal ascends the valley of the Maumee. At old Fort Defiance, at the mouth of the Auglaize River, it gives off a branch to Cincinnati, while another continues, in the same direction, to the Wabash River, in the State of Indiana.

The surface of the Maumee Basin is not hilly; but, as we advance into the interior from the lake, it gradually rises, until it attains the average altitude of eight hundred and fifty feet above the level of the sea. The post-tertiary clay deposit, so often mentioned, buries up the Silurian limestone, which constitutes the subjacent rock; over the out-cropping edges of which the river descends, by a series of rapids, eighteen or twenty miles long, which terminate at the head of the estuary. The banks of this river are in general well-developed; its inundated bottoms of limited extent. Compact and lofty forests, for some distance from it, spread out on both sides, but the upper portions of the basin abound in prairies, both wet and dry; the wide alluvial lands of many of its tributaries are subject to inundations; and on the flat summit-level between the St. Mary and Loramie Creek, a tributary of the Great Miami, there is an extensive artificial pond, designed to supply the canal with water.

II. Fort Wayne. — Where the town of Fort Wayne now stands, there was formerly a military post of the same name, and an Indian agency. The site is a post-tertiary plain, at the junction and on the right or eastern side of the two rivers which form the Maumee. This plain rises above high-water mark; but is overspread with basin-like depressions, in which foul matters and rain-water accumulate, to be acted upon by the summer sun. At the depth of twenty or thirty-feet, hard well-water, of an excellent quality, is obtained. Between the town and the river there is a slip of low ground, which, although subject to inundation in spring, formerly became dry in summer, but is now kept wet by the leakage of the Wabash and Erie canal, which traverses it. On the opposite side of the St. Mary, and of the Maumee River, there are rich alluvial grounds, under cultivation. About two miles west of the town, a grassy marsh or wet prairie begins, and stretches off, indefinitely, to the south-west. Its width is from a few hundred yards to a mile and a half. It appears to be an obsolete bed of the St. Mary, which, in former times, might have flowed, in whole or in part, into the Wabash; a branch of which, called Little River, originating near Fort Wayne, now traverses that paludal tract. The St. Mary, as it comes from the south-west, flows through the eastern edge of this swamp. Beyond the low lands which have been mentioned, there is on every side a post-tertiary plain; which, at the distance of a few miles to the east of Fort Wayne, becomes a wooded swamp — the western edge of the 'Black Swamp,' to be hereafter described, but known here under the name of 'Maumee Swamp.' Doctor Charles E. Sturgis, in a communication from which this description has been made out, says — "I could name several instances where families settled in the unbroken woods, and clearing a very small space only, enjoyed uninterrupted autumnal health for three or four years; when other immigrants arrived, and extensive clearings were made, with the consequent breaking up of a great deal of new soil, and intermittents appeared among the whole." As to Fort Wayne, from the time it was settled as a military post, down to the present day, it has been infested with intermittents and remittents; which, according to Doctor Sturgis, still occasionally present a malignant character. Of the prevalence of these fevers a judgment can be formed, from the fact, stated by Doctor Sturgis, that about four hundred ounces of sulphate of quinine are annually consumed by the people of Fort Wayne and the surrounding country. This, if we allow a drachm to each patient, would give three thousand two hundred; a large number, considering that the latitude of the town is 40° N., that the average elevation of the region is seven hundred and fifty-three feet above the sea,* and that the population is sparse, compared with regions of Indiana and Ohio which have been settled for a longer period.

III. Maumee Bay and Estuary.—Maumee Bay, in N. Lat. 41° 40′, is the south-western extremity or angle of Lake Erie, almost separated from it by two long, low, and tapering capes, which approach each other from the

* Williams: Engineer's Reports, Indiana.

north-west and south-east. The former is called North Point — the latter Cedar Point. On the southern side of the bay there are grassy flats, so depressed that the waters of the lake, when driven by winds, flow over them. On the northern side there are similar tracts, a continuation of the green margin which extends round the head of the lake, from the mouth of Detroit River.

About two miles north of the Maumee estuary, there is another and narrower,—the mouth of OTTAWA RIVER, which enters an arm of the bay. This little river has its origin, thirty miles in the interior, on either side of the boundary between Ohio and Michigan; and, for the lower eight or ten miles, runs nearly parallel to the Maumee estuary, at the distance of three miles from it. The Ottawa trough is about a quarter of a mile broad; the waters of the lake, when driven by the winds, flow up it for several miles, and are overshadowed with pond-lilies, rushes, and other aquatic plants. Some of its narrow alluvions are alternately wet and dry, or covered and uncovered, according to the direction of the winds upon the lakes. As it flows through a post-tertiary argillaceous plain, its banks are well-developed, being from twenty to thirty feet high near the bay, and attaining a greater elevation as we advance up the stream.

The isthmus between the Ottawa and Maumee estuaries, consists of the same plain, heavily timbered, and more or less infested with patches of wet-weather swamp. A narrow slip, two or three miles long, of the southern part of this isthmus, is cut off by the obsolete bed or estuary of Swan Creek, which now enters the Maumee estuary three miles from the bay, but formerly traversed the old bed. The breadth of this ravine is from two to three hundred feet, and its wet bottom is overgrown with sub-aquatic plants; its mouth, which is near that of the Maumee, is so obstructed, that the waters of the lake do not flow into it except in high wind-tides, or ground-swells. Swan Creek, above its present mouth, is a small mill-stream, flowing with a lazy and obstructed current through a winding trough, scooped out of the tertiary clay.

The narrow peninsula between the Maumee estuary and the old bed of Swan Creek, is the site of no less than three attempted towns. The first, beginning at the lake, is MANHATTAN, situated near the point of the peninsula; the second, TOLEDO; and the third, PORT LAWRENCE, which is now municipally united with Toledo.

The Wabash and Erie Canal leaves the bay at Manhattan, and passes up the northern side of the peninsula, in the obsolete bed of Swan Creek; but a side-cut brings it to the Maumee, at the mouth of that creek, whence it ascends upon the gradually rising post-tertiary plain, to the head of the estuary.

Immediately above the mouth of Swan Creek, an extensive grassy beach projects into the estuary from the high northern bank. The water which covers it is shallow, but never, I believe, entirely drained off.

We are now prepared to ascend the estuary to its head. The water is of no great depth, and varies in that particular as the wind on the lake is south-west or north-east; the former sinking and the latter raising it, through a scale from one to five feet. When the river is swollen, moreover, a rise takes place in the estuary, with a perceptible current into the lake. The bottom of the estuary is composed of Silurian limestone, a part of the same formation which is seen at the falls above. Its wooded bluff banks are high, and composed of tertiary clay and gravel. As we advance upward it gets narrower, but at its termination expands, so as to embrace several islands,—of which the largest are Hollister's and Ewing's,—all liable to inundation, under long continued north-east winds on the lake, or high floods of the Maumee River, when the estuary and bay are obstructed with ice. The banks on each side are about sixty feet high, and composed of the same material as above. Here, again, there are three new towns, of which two on the left or northern bank, called PORT MIAMI, and MAUMEE CITY, have become municipally one, under the latter name. On the opposite or southern bank stands the third, called PERRYSBURG.

At the distance of a mile above Maumee City, the river, as it descends in rapids over the limestone rocks, presents on its northern side a considerable tract of cultivated bottom, in connection with which there is an ancient bed of the river, inclosing a portion of the post-tertiary plain, called *Presque-Isle*, and augmenting the wet or semi-paludal surface to the windward of the city.

As it passes over the plain, in its progress to the south-west, the Wabash and Erie Canal sends portions of its waters into the Maumee estuary, by a series of locks, through both Maumee city and Port Miami.

PERRYSBURG, on the other side of the river, stands immediately below the demolished Fort Meigs, on a plain of the same elevation with that which supports Maumee City. To the eye, this plain appears level. It stretches off to the south-east, and beyond the limits of the town shows a wet or marshy surface, overshadowed with tall trees, compactly arranged. This is the western edge of the notorious 'Black Swamp,' to be hereafter described.

The Maumee Basin, down to a late period, was inhabited by Indians, and is, therefore, a newly settled region; yet the connections of its bay and estuary with the interior, are such as give them great prospective importance; while their topography, in itself, is of decided interest to the medical etiologist; and hence I have dwelt upon it with some fullness. It remains to say, that the various forms of intermittent and remittent fever are in accordance with the state of the surface. From Doctors Smith and Perkins, of Toledo, Doctors Conant, White, St. Clair, Matthews, Van Every, and Dwight, of Maumee City, Doctor Peck, of Perrysburg, and Professor Ackly, now of Cleveland, but formerly of Toledo, I learned that, from the commencement of settlement down to the time of my visit, in 1842, the whole locality had been infested with those fevers; cases of which sometimes assumed a malignant and fatal character. Once, during that period, they had made their annual invasion as a wide-spreading and mortal epidemic, which deserves a special notice.

IV. EPIDEMIC OF 1838 AND 1839. — The summer and autumn of 1838 were signalized by a drought, of longer duration and greater geographical extent, than had been experienced from the first settlement of the country. It extended from the River Raisin, or some point further north, round to the head of Huron River, on the south side of the lake, if not still farther east. The country, quite up to the sources of all the rivers lying between the Raisin and the Huron. suffered in nearly an equal degree under its withering influence. On the bay and estuary of the Maumee, according to Professor Ackly, no rain fell from the 3d day of July, until the 15th of October. Doctors Smith and Perkins reckoned its duration at four months. In the upper valley of Sandusky River, as Judge Cary informed me, the last rain was on the 17th of May, after which none occurred until October. At Tiffin, lower down the same river, the wells went dry before the middle of July. All the smaller streams, throughout the whole region, were exhausted, and their beds became dusty. The wild animals, of every kind found in that region, collected on the banks of the larger rivers, and even approached the towns. Deer and raccoons were numerous between Toledo and Maumee City; quails passed over the town-plat; and the frogs of the shallow and sedgy waters of the old bed of Swan Creek, now dried up, migrated in countless numbers, through the streets of Toledo, to the estuary of the Maumee. The wet prairies of the interior were dried, and the grass of the dry ones withered; the marshes and pools of the post-tertiary uplands, even those of the 'Black Swamp,' from the Maumee to the Sandusky river, were evaporated; their bottoms cracked open from shrinking; the leaves of many of the trees growing in them perished; and, in some instances, the trees themselves were killed. Under this great drying process it was, that the ordinary autumnal fever was raised into such an epidemic as had not been known before. But its sway was not equal over every part of the region in which the drought prevailed. All the accounts concur in representing, that the localities which were ordinarily the wettest, suffered most, *et vice versa.* The excavation of the canal was at that time going on, from the mouth of the Maumee estuary, at Manhattan, up to its head, at Maumee City. The laborers, four or five hundred in number, were chiefly Irish, who generally lodged in temporary shanties, while some occupied bowers formed out of the green limbs of trees. It does not appear, that a greater proportion of these operatives suffered, than of the resident population; but a far greater proportion of those attacked, died. Professor Ackly gave me a fact, which deserves to be recorded. One contractor kept a liquor store, and sold whisky to all whom he employed, which was drunk freely by themselves and their families. The mortality among them was very great. Another lodged his operatives on straw beds, in the upper rooms of a large frame house, made them retire early, kept them from the use of whisky, and nearly all escaped the disease.

The occurrence of rain about the middle of October, with a subsequent frost, put an immediate end to the epidemic; but it returned the following summer and autumn, with equal or greater violence; though affecting, comparatively, but a small number of persons. It is worthy of remark, however, that in the eastern part of the region in which the drought prevailed, the year 1838 was less sickly than the two following years. From that period down to the present time (1848), the Maumee Basin has not, I believe, been visited by a serious epidemic.

V. THE BLACK SWAMP. — Between the Maumee and Sandusky Rivers, south of the western extremity of Lake Erie, lies the great forest, which has received the ominous name of Black Swamp. The rock beneath the surface consist of the upper or grey Silurian limestone, exceedingly arenaceous, which here and there swells up into gentle undulations or tuberosities, so as to present itself at the surface; but, on the main, is buried up beneath a deposit of post-tertiary clay, with gravel and pebbles. By this deposit, the inequalities of the rocky surface are made to disappear, and, of course, it is of various depths, from a few inches to one hundred and fifty feet. The lower and thicker bed is blue clay; the upper, yellow, covered with a thick layer of black vegetable mold. To the eye the Black Swamp appears level, and in traversing it in a direction parallel to the lake shore, such is no doubt the case; but the whole region has a very slight inclination toward the lake; as appears from the accumulation of water on the south side of a State road, which passes through it from east to west, while on the north or lake side, no such accumulation takes place, to the same depth. The levelness of this tract, taken in connection with the argillaceous bottom, explains the paludal or swampy character of its surface. From this surface there arises a miscellaneous forest, of greater density and loftiness than is to be found elsewhere, perhaps, in the Interior Valley of North America.

Without passing through, I entered it a short distance on the western and eastern sides, and am prepared to concur in all that has been said of its gloomy solitudes.* While the roots of these gigantic trees, standing side by side in the compactest intercolumniation, retard the escape of the melting snows and the copious rains of spring, their overshadowing foliage so completely shuts out the sun of summer and autumn, as greatly to limit evaporation. The depth of water varies in different parts, according to their relative elevation. Doctor Rawson, of Upper Sandusky, informed me that he had seen large tracts, in which the water was from two to three feet deep, while on others it was only a few inches. Two small rivers, Toussaint and Portage, either originate in or traverse the swamp. Their troughs are broad and shallow, and, from the sluggishness of their currents, their bottom-lands, within the limits of the swamp, are liable to inundation. South of this forest, toward the summit-level between Lake Erie and the Ohio River, prairies abound; while to the north there are extensive grassy flats, skirting the lake between Maumee and Sandusky Bays.

The chief settlements in the swamp are along Portage River; where, as Doctor Peck informed me, autumnal fever prevails. The detached families which, here and there, have placed themselves in its midst, without subduing much of the forest, enjoy better health. The shade, in fact, is so dense,

* Geological Reports of Ohio.

that the sun can exert but little direct action on the surface. The destruction of the forest, and the first breaking up of the surface, will undoubtedly be attended with a great prevalence of autumnal fever.

SECTION III.

THE SANDUSKY BASIN.

I. The area of this basin is of very moderate dimensions, yet it embraces several localities of interest. The river originates on the water-shed between the Ohio River and Lake Erie, in connection with the sources of the Scioto River, whence it descends to the north, and flows into the head of Sandusky Bay. The length of this bay is about twenty miles; its breadth four or five; its axis, lying nearly east north-east and west south-west, is in the same plain with that of Lake Erie, with which it is connected by a narrow strait, formed by a head-land from the Portage isthmus on the west, and another, called Cedar Point, on the east.

II. SANDUSKY CITY stands on the southern bank of this bay, near its junction with the lake, and is separated from Cedar Point by a narrow creek or inlet, which opens into the strait; while its apex receives the waters of Pipe Creek, a small stream, which, flowing from the south-west, passes within two miles of the city, on the south. Silurian limestone rocks here constitute the shore of the bay, which is elevated, at the water's edge, four or five feet above it, and continues to rise for a short distance back, when it forms a plain, which was once a prairie. To this succeeds a lower, wood-land flat, through which Pipe Creek meanders. The rocky plain gives to the inlet which receives the waters of Pipe Creek, a firm and elevated bank; but at the distance of a couple of miles to the south-east of the city, the banks are depressed, and a tract of low grassy lake-swamp commences, and crossing the base of Cedar Point, stretches off to the east, along the lake shore, for many miles, to the mouth of Huron River. At the edge of the city-plat, to the west, there puts into the bay a small stream, with narrow alluvial grounds, over which the daily fluctuations of the bay carry its waters. To the west and south-west of the city, there are heavily timbered oak flats, for three miles, which gradually rise into a series or group of broken limestone terraces. Such is the topography of Sandusky City, which, *a priori*, is as salubrious as that of any other town on the coasts of Lake Erie; and experience proves that it is, in fact, one of the healthiest. This conclusion is sustained by information received from Doctors Tilden, Cochran, Austin, Lane, Morton, and Townsend. Malignant cases are almost unknown, and a majority of the mild are contracted in the country.

III. TEMPORARY RESIDENCE FOR INVALIDS.—No canal reaches the lake at the City of Sandusky, but here is the northern terminus of the railroad from Cincinnati, so largely traveled in summer and early autumn, when the Ohio River above that city is too low for speedy navigation; at which seasons of the year what are called the lake-fevers prevail. Traveling invalids, who, during those months, might desire to sojourn for a while on the shores of the lake, would be as safe at this point as at any other which could be selected; while several objects and facilities conspire to render it attractive to persons of taste and intelligence. *First*, a yawl-voyage across the harbor, to Cunningham's Island. *Second*, an excursion by water to the gypsum quarries on the north-western coast of the bay, where they may see nature in the very act of manufacturing sulphate of lime out of carbonate of lime containing sulphur, and carry away illustrative specimens, containing beautiful crystals of sulphate of strontian. *Third*, a more distant voyage, of thirty miles, up the bay and river, the scenery of which, although flat and tame, is full of interest. After passing the gypsum quarries, the deep water becomes much narrower, and the color appears, first, of a dirty yellowish green, and at last of a brownish hue. On each side of the channel there are extensive shallows, from which grasses, pond-lilies, and other aquatic plants rise into green savannas, animated with white cranes wading in the shallow water, and flocks of the purple grakle (*Gracula quiscula*) feeding on the seeds of grasses; as in the winter they are seen, subsisting on similar food in the salt marshes of the Gulf of Mexico at the Balize. At length a point is reached, where the shallows stretch off to the north, and coalesce with those of Portage River and Bay, which have been mentioned; then the channel divides, and one becomes the mouth of Muddy Creek, the other of Sandusky River; but no banks are yet developed, and the boat meanders through fields of aquatic herbage. Tertiary clay bluffs finally appear, and the traveler finds himself at last in the town of Lower Sandusky, which is properly the head of the estuary. Here are the site and remains of the gallantly defended Fort Stephenson; and from this place a trip may be made, on an excellent road, into the adjoining solitudes of the Black Swamp. *Fourth.* Returning to the city, they will find other subjects of interest. A visit, by land, to *Castalia*, a few miles south of the city, where they may quench their thirst in the waters of '*Cold Spring*,'—a pellucid fountain, copious enough to turn mill-machinery,—which boils up through a deep rent in the Silurian limestone. *Fifth.* A voyage of a few hours to Maumee Bay and estuary, already described, at the head of which, near Maumee City, they may wander over the battle-ground of Wayne, in 1794, the site of Fort Meigs, and other localities of deep military interest. *Sixth.* A voyage of somewhat greater length, to the River Raisin, and a view of its bloody battle-field. *Seventh.* An afternoon's voyage to Detroit, with which there are so many interesting historical associations.

IV. VENICE is a hamlet on the southern shore of Sandusky Bay, four miles from the city, at the spot where Cold-spring Creek discharges its waters into the bay. From the city to this point the bank is so high as not to be overflowed; but immediately above the hamlet, one of those broad shoals, so common around Lake Erie, begins and extends up the bay for several miles. The depth of overspreading waters varies according to the direction of the wind upon the lake, but the surface is never dry. It is destitute of trees, but densely covered with aquatic grasses, and other herbaceous plants. At all times, the people of the hamlet, standing, as it does, to the leeward of this permanently overflowed ground, have been subject to intermittent fever, which has sometimes, especially in former years, assumed a malignant type.

Of the autumnal health of the people living round the bay above Venice, I could not obtain a reliable account; but was told that it is better than that of those who inhabit the banks of the rivers which flow into it; which was ascribed to the depth and daily agitation of the waters from the fluctuations of the lake.

V. LOWER SANDUSKY.—Like Monroe, on the River Raisin, and Maumee City and Perrysburg, on the Maumee River, this town stands at the head of what corresponds to tide-water of the ocean; that is, at the highest point of lake influence; like them, also, it lies at the foot of long rapids, for those of the Sandusky River terminate at this place. The town, built on the west or left bank, covers a narrow terrace near the river, and ascends upon a higher, which is, in fact, the eastern edge of the Black Swamp. On the opposite side, is the newer and smaller town of Croghansville. The river-bottoms above and below the town, are narrow; and the former especially seem, from the rapid descent of the river, but little subject to inundation. The surrounding upper plain has, from clearing and cultivation, lost its marshiness, and shows what the whole of the Black Swamp might be made, under the same treatment. Thus, Lower Sandusky presents but few conditions favoring the production of autumnal fever. Nevertheless, that fever is far more prevalent here than in Sandusky City. Doctor Anderson, who had resided longest here, had, from the time of his arrival, encountered that disease. In former years, his practice extended for many miles down the estuary, and up the river along the rapids; during which he observed that the people below enjoyed better autumnal health than those above. Doctor Rawson, who had also been many years in the same place, testified to the frequency of that form of fever; the other physicians, in a very brief residence, had met with it; and Doctor Williams, of Croghansville, bore testimony to the same fact. It is probable, that the margins of the Black Swamp, lying to the windward of the town, are one source, at least, of this disease, which in 1838 and 1839 was as prevalent and violent here as at Toledo.

VI. TIFFIN.—The road, on the west bank of the river, up to Tiffin, runs over the cultivated margin of the Black Swamp; the marshes and swales of which are either drained or dried by the hand of cultivation. The river abounds in rapids, formed by the out-crop of the Silurian limestone. The bank, for the whole distance, twenty miles, appears to be at the same elevation above the river, showing a gradual inclination of the plain to the north.

The town of Tiffin stands immediately above the junction of Rocky Creek with the Sandusky river. The latter bounds it from the south-west round to the north, where the two streams unite; when Rocky Creek constitutes the boundary from that point to the south-east. Just above its mouth there is a mill-dam, which creates a pond; and below, there is a dam across the Sandusky River, which gives a pond to the north-west and west. Doctor Dresbach has observed, that much of the autumnal fever of Tiffin was in the neighborhood of these ponds. Several times they have been drained in July, and the fever soon afterward broke out. The rapids of the Sandusky are still seen at this place. The bottom-lands are narrow. The post-tertiary plain, originally wet, is becoming dry under cultivation. From the statements of Doctor Dresbach, confirmed by Doctor McFarland, autumnal fever prevails more in this locality than at Upper Sandusky. Its greatest prevalence is in the Black Swamp, to the west and south-west of Tiffin. During the great drought of 1838, many of the swamps and swales were entirely evaporated; and the roots of previously vigorous plants became so dry as to burn like turf. Almost every family was taken down with fever.

VII. Upper Sandusky.—This village, until lately the center of the tribe of Wyandot Indians, now residing at the mouth of Kansas River, represents the upper portion of the Sandusky Basin. The streams in this region are the Sandusky proper, with the Broken-Sword, to the east, and the Tyamochtee, to the west. The two former originate in extensive swamps, and flow for some distance, westwardly, through a dense forest; the last, originating to the south-west, and flowing northerly, drains a gently-rolling tract of prairie and open wood-land. Near the banks of this branch of the Sandusky, is the spot at which Colonel Crawford was burnt by the Delaware Indians, in 1782.

The general character of the upper basin of Sandusky River, except its eastern part, where there are swamps, is favorably dry and salubrious. The prevalence of autumnal fever is unequal, but, on the whole, not great. Its latitude is a little below 41° — its elevation about nine hundred feet above the sea.

SECTION IV.

BASIN OF HURON RIVER.

I. The mouth of this little river (which lies chiefly within Huron county, Ohio) is ten or twelve miles east of Sandusky City; its sources about thirty miles in the interior. In coming into this basin from the Sandusky River, we leave the Silurian limestone, for the superincumbent Devonian or black slate and sandstone, of the Appalachian coal formation. Many of the smaller streams have foul and tortuous beds. The estuary of the river extends to Milan, seven miles from the lake. Between the two there are flats and swamps, which likewise stretch westwardly along the lake, to Sandusky City.

II. A town, called Huron, has grown up at the entrance of the river into the lake, notwithstanding the locality seems, at all times, to have been unhealthy. A Canadian-French trader, who established himself there as early as 1793, told Judge Lane, of Sandusky City, that it was at first healthy, but with the progress of immigration, fevers appeared. From Mr.

Bolt, of Norwalk, twelve miles in the interior, I received the following facts. He was one of a family of eleven persons, who, in the month of August, 1822, landed where the town of Huron now stands. One of the party and himself remained on the spot for an hour only; but the other nine lodged there through the night, and then proceeded into the country. Within a fortnight the whole nine were taken down with fever, but he and his companion escaped. Some time afterward, not in the same year, he went, in autumn, from the healthy part of the country, where they resided, to the estuary of the river, and spent three days and nights upon its banks, about three miles from the lake; at the end of which time he was seized with intermittent fever. Twenty years after that time, as I was assured by Doctor Baker, of Norwalk, this locality was still infested with the same fever, to a much greater degree of malignity than the country around, or even the town of Milan, at the head of the estuary.

III. Norwalk. — This beautiful town stands five miles south of Milan, at a higher level, on one of the sand-dunes or terraces which lie parallel to Lake Erie. The covering of sand is but a few feet in depth, and rests upon the wide-spread post-tertiary clay deposit, so often mentioned. This deposit makes the bottoms of the wells in Norwalk; which are, therefore, only five or six feet deep. The fine sand of this terrace, when dry, is constantly raised into the atmosphere by the wind, and carried through every opening, into all the houses of the town. A reference to this condition will hereafter be made, in connection with other forms of disease than the one which now receives attention.

This locality might be expected to escape autumnal fever; but according to Doctors Baker, Kitteridge, and Tift, it does not. Doubtless, the immediate cause of the fever is not developed on the sand ridge, but at the distance of two miles to the west, where the ridge terminates, and a foul tributary of Huron River, with a dam and pond, exists.

Doctor Tilden, now of Sandusky City, was one of the earliest physicians of Norwalk, and from him I learned that, in the beginning of its settlement, intermittents, sometimes of a malignant and soporose character, prevailed. He also gave me the following fact.

IV. An Epidemic Fever. — Early in the summer of 1819, there was an unusual drought, when, on the last Wednesday of June, a great rain fell on a tract five or six miles wide, extending from south-west to north-east, across Huron county, near Norwalk. In the space of a fortnight afterward, within those limits, eight horses died from fever, as their thirst and increased heat of skin clearly evinced. Sixty families inhabited the district, of which, soon after the fall of rain, fifty presented cases of autumnal fever, ranging from simple intermittents to remittents, which even simulated yellow fever. There had been much clearing of new lands, and the virgin soil had been extensively broken up.

V. Monroeville is a smaller town than Norwalk, situate on the west bank of Huron River, without anything peculiar in its topography. Doctor Cole conducted me to a small stream in its vicinity, where there was a mill-dam, which had created an exceedingly foul pond, having connected swales, bayous, and shallows, in which the trunks and limbs of trees were undergoing decay. Near the mill there was a hamlet, which, he assured me, suffered preëminently from autumnal fever, compared with the surrounding country.

To the west of Monroeville there are many broad prairies, which, under a rapid settlement of the country, were extensively plowed up, in a short time. The oxen were turned out in the evening upon the unplowed prairies, and were the next morning driven in, by *wading* after them through the tall grass, bending with dew. The persons who performed this duty were generally attacked with intermittent fever.

In reference to Huron county generally, Doctor Baker assured me, that tracts in which the clay deposit came to the surface, were more exempt from fever than the prairies, which had a deep covering of soil, or even the sand ridges.

SECTION V.

BASIN OF BLACK RIVER.

I. The River. — This little basin, of the same class with the last, lies to its east. The sources of Black River, like those of the Huron, although within forty miles of the lake, interlock with the head-waters of the Muskingum, on a summit-level of nine hundred and seventy-eight feet above the sea. In its geological structure, the Black River Basin is composed of the Devonian slate and sandstone, supporting conglomerate, the whole of which dip to the south-east, beneath the Appalachian coal deposits. Much of the surface between Huron and Black Rivers, in the neighborhood of the lake, seems to be composed of disintegrated slate, forming an argillaceous bed, gently inclining toward the lake, and abounding in sand ridges, drifted by the winds or waves, when the surface of the lake was at a higher level than at present.

II. Elyria, the chief town of this basin, stands six miles from the lake, immediately above the junctions of the two principal branches of Black River. Below the town there are cascades in both; and then comes the estuary of the common trunk, with its flats and lake marshes. Each branch of Black River, has a dam above their junction, by which the town is subjected to the influence of a pond, both to the east and west. From Doctor Manter, and Doctor Howard (now a professor in the Starling Medical College), I learned, that the Black River Basin, generally, is subject to autumnal fevers; which the former gentleman had observed to be decidedly more frequent and dangerous along the estuary of the river, than about Elyria or elsewhere.

SECTION VI.

THE CUYAHOGA BASIN.

I. General Description. — This basin, which, in area, will bear a comparison with the Sandusky, lies east of the one just described. The junction of the Cuyahoga River with Lake Erie, is at the well-known city of Cleveland, in N. Lat. 41° 31′, and W. Long. 81° 46′. Although the river is more than sixty miles in length, its extreme sources are within ten miles of the lake, east of Cleveland, whence the river flows to the south-west for more than half its length, when it turns toward the lake, and unites with it, by flowing directly north. In the course of this great *detour*, it descends by falls and rapids two hundred and forty feet. The head-waters of this river are on table-land, the general elevation of which is about eleven hundred feet* above the sea, or more than five hundred feet above Lake Erie. Its connections on this elevated level are, chiefly, with the Mahoning branch of Beaver River, which joins the Ohio thirty miles below Pittsburgh. At the junction of the Cuyahoga with the lake, the black slate is the lowest formation; in advancing from the shore, sandstone appears at a higher level; and in ascending upon the table-land of the upper part of the basin, we reach the conglomerate, on which rest coal beds that are worked. We have, in fact, here re-entered the great Appalachian coal basin, by its northern border. At first view this would not be perceived, for the aspect of this tract is different from that presented by the rim of that basin elsewhere. From Alabama to Pennsylvania, wherever we have approached it, the out-crop of conglomerate which supports the coal, has presented groups of high hills, connected by rocky spines, or rising, when distinct, into lofty cones, while deep and narrow gorges have taken the place of broad alluvial valleys, and swamps and ponds have been replaced by mountain torrents. Here, however, the peaks and summits have been removed nearly down to the level of the ravines; a sterile hill-country has thus been transformed into an elevated and fruitful plateau, incumbered with masses of its own rock, intermingled with huge granitic bowlders, brought from some distant region of the north, perhaps, by the currents which effected the destruction of the hills. On this ancient geological change, depends its present medical topography. The general levelness of the basin gives to the streams a sluggish current, with wide alluvial grounds, subject to inundation; ponds are numerous, and extensive swamps not uncommon — the river itself rising in one of them.

Every part of this upper Cuyahoga Basin is annually more or less infested with autumnal fever, although elevated eleven hundred feet above the sea, and in the mean latitude of 41° 30′ N.; but the banks of the ponds and marshes are most infected. Thus, I was told by Mr. Coles, of Chardon, that when a dam was built across the Cuyahoga, at Burton, the people were, in the two next years, generally attacked by autumnal fever; and Doctor Hamilton, of the same town, informed me, that in the neighborhood of Burton, a

* Ohio Geological Reports.

dam was demolished in summer or autumn, and nearly all the laborers engaged in the work sickened with fever. From Doctor Bennett, of Shalersville, I received the following facts. The Cuyahoga flows near the western side of that village, from north-east to south-west. To obtain water for the Mahoning Canal, a dam was thrown across the river, which gave rise to many cases of fever. Two years afterward, a higher dam was erected, lower down the river, which raised the water to the level of the first; involved the ruin of an old mill; produced stagnant water in the mouths of many small streams; inundated some forest land; and so intercepted the volume of water flowing in the river, that when it became reduced, in autumn, the whole was transmitted through the canal-feeder; leaving but a series of pools, in the partially dried-up river-bed below. During the first autumn after this signal change in the condition of the river, no injury to health was experienced; but in the next, nearly all the inhabitants, on both sides of the river, above and below the new dam, were attacked with autumnal fever. The number of cases was estimated at one hundred and fifty. They who lived near the river, had intermittents; those who resided further off and on higher ground, suffered more from remittents.

II. Ravenna stands on a slight eminence, from which the rains flow off in all directions. At the distance of a mile, a tributary of the Cuyahoga winds round the town-site, from east south-east to west north-west. On this stream, two miles south-west of the town, a mill-dam was erected in the early period of settlement, and for five or six years, as Doctor Swift informed me, the people of the village and neighborhood were subject to intermittent fever. In 1819, the dam was demolished, and the bottom of the pond laid bare, when nearly all the inhabitants sickened with a malignant fever. In 1820 there was much less, and for the next fifteen years scarcely a case, except those contracted elsewhere. The Mahoning canal was then excavated, in the valley of the same stream, since which cases of fever have multiplied.

III. Cuyahoga Falls. — The town which, because of its locality, bears this name, is situate on the right or north-west bank of the river, where it enters the chasm through which it descends to its lower level. The inhabitants of the western part of the town, near the falls, as I was assured by Doctor Rice and Mr. Sill, are almost entirely exempt from autumnal fever; a fact worthy of being noted, as bearing on the opinion that the vicinity of a water-fall is insalubrious. Further up the river, there is a dam, causing a pond opposite and beyond the eastern part of the town, and three miles above, at Monroe, there is another. The gentlemen just named informed me, that nearly all the autumnal fever of their locality, occurs to the north of the lower pond; and Doctor Wright, of Talmadge, had, along that section of the river, no less than one hundred and fifty cases; while not a case occurred in his own village, which lies beyond the influence of the stream.

IV. Hudson. — Doctor Town, of this place, who had practiced in it, and throughout the great bend of the Cuyahoga, for seventeen years, informed me, in a comprehensive manner, that autumnal fever had prevailed in all its localities, but to the greatest extent by far along its water-courses, including the Cuyahoga. The least prevalence was in the town. Intermittents, especially, occurred on their banks; remittents in remoter and dryer places. In latter years, they are less frequent than formerly.

V. AKRON stands a few miles south of Cuyahoga Falls, on both sides, but chiefly the eastern, of the series of twelve or fourteen locks, by which the Ohio and Erie canal descends from a summit-level of three hundred and ninety-five feet above Lake Erie, and nine hundred and fifty-nine above the sea. The descent is down the steep valley of a small stream. The excavations for the locks, were made through a deep deposit of transported or tertiary materials. On the summit-level, the Mahoning canal traverses the eastern part of the town, to join that from the Ohio River. The water of the former is but slowly drawn off, and, therefore, stagnates. That of the other, from the constant ascent and descent of boats, is kept flowing. Near the junction of the canals there are two ponds and a marsh, and, at the distance of two miles, there is an extensive swamp; all lying to the south of the town. Near the locks, on the east, there is a marsh of twelve or fifteen acres, and, adjoining them, to the west, a series of little pools and swampy spots, created and kept up by the leakage of the locks. Thus, on the whole, marsh-exhalations, from the surface of the ground, and from the waters of the canal in their descent through the locks, together with aqueous vapor, must abound in this locality, as much as any other in the whole country. At a lower level, in a lower latitude, the fevers of autumn would, doubtless, be more violent than in this place; but, according to the evidence of Doctors Cole, Wallace, and Angel, intermittents and remittents prevail every summer and autumn, to a decided degree, both as to the number of cases, and their occasional violence. Compared with the towns of Ravenna and Cuyahoga Falls, the topographical conditions of which are, *prima facie*, more salubrious, Akron must be regarded as sickly.

VI. THE CANAL FROM AKRON TO CLEVELAND.—Doctor Cole was in Akron in the summer of 1825, when the excavation of the canal in the direction of Cleveland was commenced. The laborers suffered extremely from fever; at least eighty of them were his patients; but, as they worked in the valley of the Cuyahoga, they might have suffered, if they had not been engaged in exposing the fresh earth to the action of the atmosphere, sun, and rains. In 1826, many persons came from the surrounding country to work on the canal, and dispersed in June; but Doctor Cole afterward learned, that as large a proportion of those who went away as of those who remained behind, were seized with the fever. In 1827 and 1828, the same kind of fever returned. In the former year the water was let into the canal. In 1829 and 1830, but few cases occurred. In excavating the canal and the pits for two locks, within the limits of the city of Cleveland, in 1827, the laborers threw up a great deal of vegetable mold, and both they and the people of the town suffered severely from fevers; some cases of which might, by their symptoms, have been ranked with yellow fever. Doctor Long, of

Cleveland, remembers, that nearly the same results followed on the excavations all the way to Akron.

The result of my inquiries at this place, concerning the health of the canal boatmen, was, that although the boats are run throughout every night, and also, through the hottest part of the day, the men are less subject to autumnal fever, than the people of the country through which the canal passes.

VII. Lower Valley of the Cuyahoga. — The river below the falls and the Akron locks, flows through a kind of gorge in the black slate, and in some places presents rapids. Before reaching the lake, its valley widens, the stream becomes more tortuous, and its current slackens; in consequence of which, an immense quantity of drift-wood is lodged upon its margins. Many of its bottoms are liable to inundation, and the whole are overspread with rank herbaceous vegetation. As the river nears the lake, the sluggishness of the current increases, and opposing winds drive the waters of the lake more or less into its estuary, which is five or six miles long. The effect of such winds formerly was, to roll the sands of the lake beach into the mouth of the river and choke it up; the obstruction being made greater, by the silt deposited from the stream, when its current was arrested. In times past, the river, thus turned aside, probably entered the lake at various points. On the settlement of Cleveland, as Doctor Long informed me, the mouth was seventy or eighty rods west of where it now is; and there remains to this day, a section of the river-bed, filled with water ten or fifteen feet deep, which exactly resembles one of the crescent lakes in the trough of the Mississippi.

On each side of this linear pond there are marshes, which extend up to the Cuyahoga. On the outer edge of the marsh, next the lake, there stands a tuberosity, several feet high, which, from its composition, is a remnant of the tertiary plain, which forms the bank of the lake, east and west of the mouth of the river. Immediately south of this marsh the river flows at the foot of a considerable bluff, and has a low and wet bottom on the opposite or eastern side; further up, the bottom is found on the western side, and then again on the eastern. These bottoms were once covered with forest. Their elevation is from three to four feet above ordinary high water. Formerly, when the river was obstructed at its mouth, these bottoms were occasionally inundated. At that time a pool was created in the estuary, which, in summer and autumn, when the river was low, became foul, and emitted an offensive smell, quite perceptible along its banks. The erection of two piers, projecting a considerable distance into the lake, by arresting the movement of sand, and compressing the river into narrow limits, has enabled it, when in flood, to wash away the bar, and thus preserve the purity of its estuary. Beyond the marshes and bottoms which have been designated, on both sides of the river, there are tertiary clay and sand plains, about eighty or ninety feet above the surface of the lake. West of the mouth, the broad marshy beach prevents the action of the waves upon the bank, but to the east the erosion of their foundations is so great, that extensive slides have taken place.

VIII. Cleveland. — The beautiful city of Cleveland, the settlement of which was begun by immigrants from New England, in 1796, stands chiefly on a dry post-tertiary plain, immediately east of the junction of the river with the lake, fronting on both, and extending down to the river's edge. Being to the leeward of the river, with its bottom-lands, and of the old bed of the stream on the lake beach, with its marshes, it is exposed to whatever insalubrious exhalations may arise from them. At an early stage of its settlement, according to Doctor Long, these exhalations were very pernicious, as intermittent and remittent fevers, frequently assuming a malignant type, were common; but in latter years they are greatly mitigated. The same testimony as to their present mildness and rarity, has been given me by Professor Ackly and Doctor Mendenhall. In the course of his long experience at this place, Doctor Long observed, in some years, a great predominance of the intermittent type, in others of the remittent. The seasons which favored the former were wet and cool — those in which the latter prevailed were hot and dry. Malignant cases did not show themselves until about 1827, many years after the settlement of the place began.

IX. Ohio City is but an extension of Cleveland, upon the bluff of the western side of the river. In reference to autumnal health, it has the important advantage over the older and larger town, of being to the windward of all the low, wet, and foul grounds which have been mentioned; but, on the other hand, there is a considerable terrace-swamp, in Brooklyn township, at the distance of two or three miles to its south-west or windward. Doctor Mendenhall has given me two observations made on the site of Ohio City, which deserve to be recorded: *First* — laborers and watermen have been occasionally boarded and lodged on the edge of the swamp, near the west bank of the river, and they were exceedingly liable to intermittent fever. *Second* — in the southern part of the terrace on which the town stands, a deep excavation was made, in the bluff bank, to form a road of easy ascent, and the bluish clay thrown out, was used to fill up a street below, the effect of which was, to cause a local prevalence of autumnal fever.

SECTION VII.

BASIN OF THE CHAGRIN.

Chagrin (more properly *Chaguin*) River enters the lake eighteen miles east of Cleveland; between which and it there are broad and elevated lake-terraces, generally free from swamps, well-cultivated, and partially defended from the winds and vapor of the lake, by a belt of woods. When I traveled on this terrace, in the month of September, 1842, the inhabitants appeared to be generally free from fever.

The sources of the little River Chagrin are on the northern edge of the conglomerate plateau, near those of the Cuyahoga, at an elevation of about twelve hundred feet above the ocean, and near six hundred and thirty above the lake. Like the Cuyahoga, this river runs, for a short distance, to the south-west, to find a depression through which it may descend to the lake. In common with all the rivers of this region, it has its cataracts; from which it descends, by a rapid current, which is not checked until it arrives within a mile of Lake Erie. Its alluvial borders are narrow, and not subject to inundation; the upper part of its bed is composed of conglomerate, the middle, of Devonian sandstone, and the lowest, of black slate; finally, its cold and limpid upper waters abound in speckled trout (*Salmo fontinalis*), the popular sign that ague and fever need not be apprehended.* On this point I can only say, that Doctor Card, of Painsville, who formerly resided in the village of WILLOUGHBY, two miles from the mouth of the Chagrin, informed me, that the country further up the river, was but little infested with autumnal fevers. It is otherwise, however, around the short estuary near the lake. The marshes, it is true, are of very limited extent; but the mouth of the river is generally choked with sand, and the free exit of its waters prevented. In the early stages of the settlement of the country, this limited locality was infested with fevers of a dangerous character. In the autumn of 1823 or 1824, nearly all the settlers were ill; and it was observed that of the citizens of the village of Willoughby, only two miles up the river, who went to their relief, nearly all sickened, while those who remained at home, continued in health. Willoughby itself is not, however, exempt from autumnal fevers; but, as Judge Allen and Doctor Card informed me, they are less prevalent than formerly.

SECTION VIII.

BASIN OF GRAND RIVER.

I. The mouth of Grand River, is found twelves miles east of the one just described. Its sources interlock with those of the Cuyahoga and the Mahoning, at a mean altitude of eleven hundred feet above the sea. To descend from this elevated plateau, it takes a direction somewhat east of north, and after reaching the lake terraces, flows nearly west, through a channel which at length becomes remarkably tortuous, and with a sluggish current, which is arrested three miles before it reaches the open lake. When high, its water is turbid, at other stages brownish, but transparent.

II. On each side of the mouth of this river there is a marsh, the two covering about one hundred and fifty acres; but beyond the western, there are other swamps of great extent, separated from the lake by a narrow slip of higher land; beyond which, one of them, containing fifteen hundred acres, opens out to the lake. On account of the long piers, at the mouth of this river, the fluctuations of the lake are not much perceived in the estuary. The surrounding plain, fifty or sixty feet above the lake, is composed of transported or post-tertiary materials, resting on the black slate. Much of the water obtained by sinking wells into the plain, is of an inferior quality. The

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* Ohio Geological Report.

village of Fairport stands on a peninsular portion of the plain, immediately east of the mouth of the river; that of Richmond, a mile from the lake, on the western side, being built on two terraces. The prevalence and malignity of autumnal fever in these towns, have generally been quite as great as the etiologist would anticipate, from the unfavorable character of the neighboring topography. Information afforded me by Doctors Matthews, Card, Rosa, and Livingston, indicated that they were familiar with all the forms (up to the most malignant) of intermittent and remittent fevers, which infest similar localities in the south; but all concurred in representing the prevalence of those diseases as decidedly less than in the first years of the settlement of the country.

III. Painesville. — The site of this town, on the left or west bank of Grand River, is eight or nine miles from the lake, following the meanders of the stream, but only three miles, in a direct line. The slaty banks of the river are well-defined, and above its highest freshets. Much of the town-site is a deep and movable bed of sand. Like Norwalk, in fact, the town stands on one of the sand ridges which run parallel to the lake. In a ride with Doctor Rosa, to the south, in the direction of the highlands, I observed that we traversed several of these low ridges, between which, the more argillaceous surface was swaly. The swamps, however, which are near enough to Painesville to exert on it a mischievous influence, are those which have been described; all of which lie either to its north or north-west, and between them and the town there is a dense forest. According to the medical gentlemen whom I have quoted, the prevalence of autumnal fever in Painesville is small, compared with Fairport and Richmond.

SECTION IX.

LAKE SHORE, FROM PAINESVILLE TO BUFFALO.

I. From Painesville, Ohio, to Erie, Pennsylvania, the distance is seventy-three miles. Between them there is no considerable river, nor any town of interest. The summit-level, between the Ohio river and the lake, through the whole distance, lies near the lake, and thus all the streams running into the latter are short. At Erie, its distance from the lake does not exceed ten miles. This part of the coast is, in fact, that to which the waters of the Mississippi make the nearest approach.

II. Town of Erie. — The site of Erie is a post-tertiary or diluvial terrace, forty or fifty feet above the level of the lake; from which it is defended by a long peninsula, the *Presq'-Isle* of the Canadian French, who once had a settlement at this place. Between this peninsula and the town is the excellent harbor, which is entered from the east, and opposite which entrance there is a margin of lake swamp lying north-east of the town. A small stream traverses the eastern part of the town-plat, to join the lake near the narrowest part of the passage into the harbor. The bed and banks of this stream are composed of black slate, which has such a thin covering of transported materials, where the town is built, that many of the wells, not more than twenty feet in depth, afford water of an aluminous quality. The surface of the plain is more argillaceous than that of many other localities on the south side of the lake. To the south-west of the town, where the peninsula is connected with the main land, there was a swamp, which has been partially drained. The peninsula, generally, is but a bank of sand, bearing trees, and having here and there a small swamp or pond. South of the town, at the distance of two miles, there is a second and higher terrace, running parallel to the lake shore; in front of which there lies a hemlock swamp, fed by springs and rains; the larger part of which is to the summer-windward of the town. The Beaver and Erie Canal, by traversing, has partially drained it. Beyond this there are other terraces, bearing timber, and having more or less of swamp.

It appears from this description, that the medical topography of Erie, in reference to autumnal fever, is not of the most favorable kind. The late Doctor Johns, who settled there in 1822, found intermittent fever especially prevalent in the suburbs of the village to the south-west, near the stem of the peninsula, where marshes abounded; and also to the north-east in the vicinity of the same kind of surface. Remittent fever occurred in the central parts of the town; but for the first fifteen years he never saw a case of intermittent originate there. In 1839, the excavation of the Erie and Beaver Canal (*p.* 282) was begun; and continued till the close of 1841. From its commencement up to 1842, when I was there, intermittents had appeared among the people of the town, especially those living in its western parts, near the canal; and, on a second visit, in 1847, I learned from Doctor Wallace, Doctor Vosburg, and Mr. Sill, that intermittents continued to be prevalent throughout the whole, and that, by common consent, they were ascribed to the canal. Perhaps a partial draining and disturbance of the surface of the hemlock swamp, may have contributed to this insalubrity. The intermittents were generally of a mild character.

III. Lake Shore from Erie to Buffalo. — From the town of Erie to the city of Buffalo, ninety miles, the lake coast runs nearly north-east, and for half the distance, that is, to Dunkirk, the high table-land on which the far-reaching sources of the Alleghany River, including Chautauque Lake (*Ch. X., Sect. I*), have their origin, approach and terminate in rocky escarpments within eight to twelve miles of the lake shores. As that river belongs to the Mexican Basin, the Lake Basin here presents but a narrow belt; which lies about six hundred feet below the neighboring summit-level. All the streams which traverse this belt are but mountain rivulets, and their estuaries are correspondingly limited, as are the marshes of the lake shore. The terraces, so often referred to, rising above each other, as we advance from the lake, are found in this belt; but the amount of diluvium or transported materials is less; and for many long reaches, the road passes over the black Devonian slate, without any intervening deposit. East of Dunkirk the same condition of the shore continues, but the belt widens; the coast and the highlands diverge from each other; and the little river Cattaraugus (its cold upper waters abounding in speckled trout), by a length of fifty miles, and a descent of eight hundred feet, shows that the lofty plateau on which its head-waters mingle with the sources of the Alleghany and the Genesee Rivers, is comparatively distant. The highlands continue in sight, however, until we arrive within twelve or fifteen miles of Buffalo. Of the state of autumnal health, along the coast, from Erie to the Buffalo flats, which we encounter before reaching the city, I cannot speak from information, but, judging by its surface, would regard it as better than that west of the town of Erie.

SECTION X.

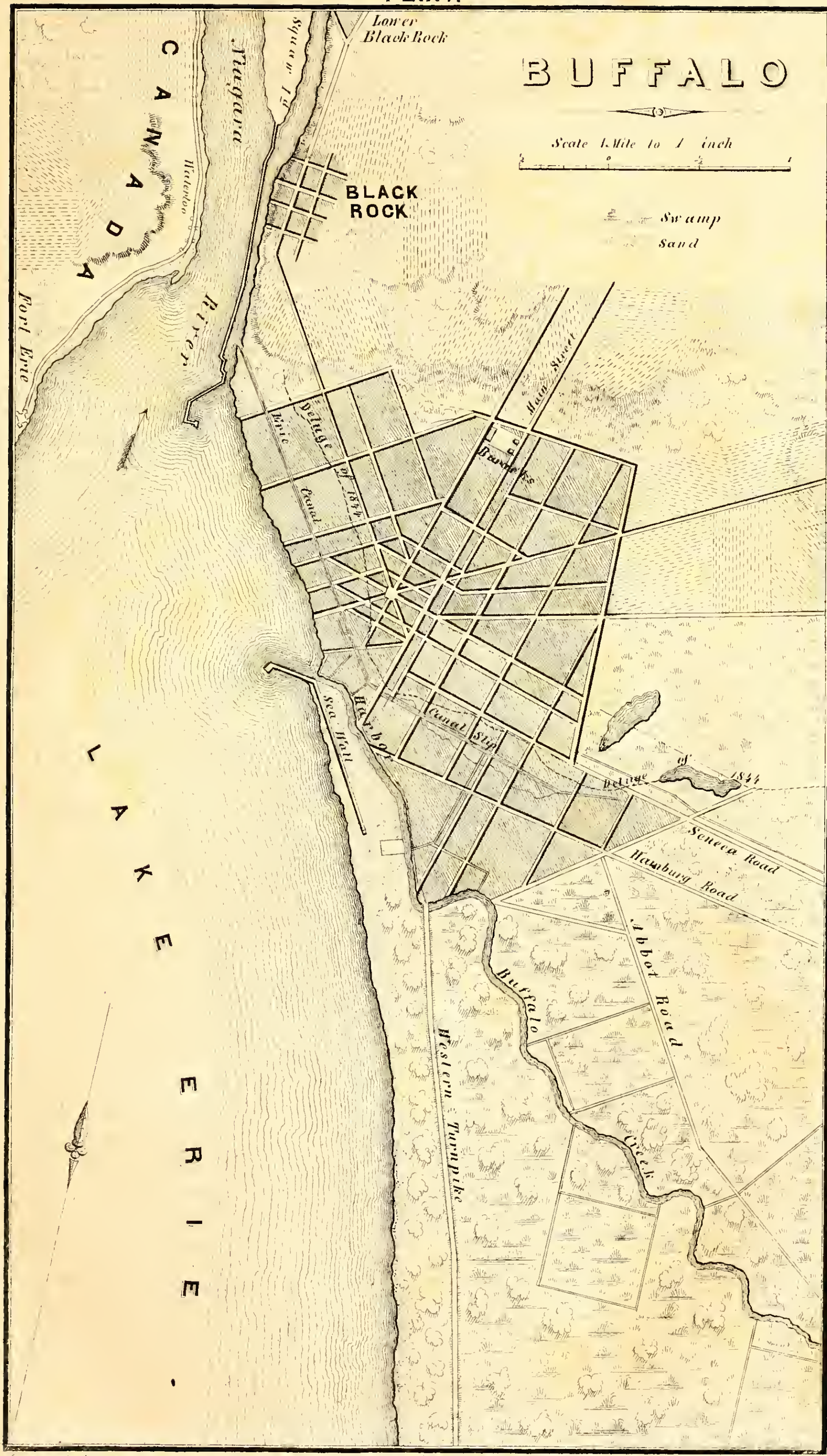
CITY OF BUFFALO.

I. We have now reached the lower or eastern extremity of Lake Erie, where we find an extensive plain, which rises but a few feet above the surface of the lake. We have descended from the high terrace, on which we traveled round the southern side of the lake. The coast here runs nearly north and south. The city begins on its very margin, near the right bank of Niagara River. To the south and south-east, the plain, over an area of many square miles, is so low and level, as to have received the name of the *flats*. Their position, in relation to the city, may be seen in *Pl. XV*, but not their limits to the south-east, for they extend beyond the boundaries of the map.

These flats, once covered by the lake, were, at the beginning of settlement, overshadowed by a heavy growth of timber, much of which still remains. They embrace many ponds and swamps, and all parts are too wet and boggy for cultivation, until they are ditched. The water which drains from them is of a dark-brown color. Their western margin, for a considerable distance, is separated from the lake by a narrow belt of higher terrace, which gradually widens in going westwardly up the lake.

Buffalo Creek, the sources of which interlock, at a high elevation, with those of Cattaraugus Creek, and certain branches of the Genesee River, presents toward its sources, lively currents of pure cold water, abounding in speckled trout. The creek descends to the north-west, and on entering the flats, its velocity slackens, and it becomes discolored, by the oozings of the marsh. Before it reaches the lake, it is reinforced by the waters of Little Buffalo Creek, entering it from the north-east. The approach of Buffalo Creek to the lake is at an acute angle, the course of the stream being nearly north. The junction takes place near the middle of the western line of the city, as may be seen upon the map. The deep and narrow estuary of this stream constitutes the harbor of Buffalo. For a couple of miles south of its junction, the neck of land between it and the lake, is a low sand-dune, over which the water, when impelled by westerly winds, sometimes breaks into the creek.

PL. XV.



Lith. by A. Weber. Face p. 380. C. A. Fuller U.S.C. Engr.

During a remarkable storm, on the night of the 18th of October, 1844, the waves were driven, in a deluge, into this part of the creek, and upon the flats, generally, to the depth of six, eight, and even ten feet. They also inundated the western and southern parts of the city, as may be seen by the dotted line on the plate.

The plain on which the city stands rises in a very gradual manner, and, beyond the line just mentioned, is above the highest known lake-floods; some parts of it finally reaching the estimated elevation of sixty to eighty feet. To the north-west of Main street, which nearly bisects the city from west to east, the surface abounds in low sand-dunes, or ridges; to the south-east of that street, it presents a more argillaceous character, and includes swales, superficial marshes, and even considerable ponds, which discharge their superfluous waters into Little Buffalo Creek.

The inhabitants are supplied with well-water, obtained at very unequal depths, and exceedingly various in quality; some of it being, as Doctor White informed me, offensive to the senses.

The Erie canal enters the front of the city from the north, and passes through it, near the lake, to terminate on the southern side; being connected with the estuary of Buffalo Creek by several lateral cuts. The vast commerce of Buffalo keeps the natural and artificial canals of its western or lake side, crowded with schooners, propellers, steamers, and boats, from which all manner of impurities must, of course, make their way into the stagnant water. The water, however, is not really stagnant, for the westerly winds drive that of the lake up the creek, and through several slips into the canal; and the easterly draw it out, by repelling the lake from the shore; and thus, much of the filth is carried away.

The position of Buffalo is in N. Lat. 42° 50′, and W. Lon. 79° 23′. The elevation of most of its plat is about five hundred and eighty feet above the sea. Its settlement commenced in 1801, when the surrounding country was a wilderness, and what is now the south-western part of the city was a morass. Its growth was slow; and being burnt, during the war with England, it recommenced the year 1814, with only four houses. Thirty years afterward, its population amounted to thirty thousand, and at this time (1848), may be estimated at forty thousand. Thus it is a new city, built on a spot which, until recently, was covered with forest.

The extensive paludal and boggy tract which lies immediately south of Buffalo, together with the impure waters of the canals and the estuary of the creek, are hydrographical conditions eminently favorable to the production of autumnal fever. Let us see in what degree they are really pernicious. Doctor Trowbridge began the practice of medicine at Buffalo in the year 1810, and has continued on the spot ever since. Intermittents and remittents (some of which were malignant) prevailed from the beginning. In some seasons the higher parts of the village were most infected; but generally, these fevers occurred chiefly in the vicinity of the two Buffalo Creeks. With the progress of rural and civic improvement, they have regularly diminished; until, at the present time, remittent fever is rare, and intermittent almost unknown, except in the suburbs of the city. From Professors White, Flint, and Hamilton, I learned, also, that but little autumnal fever is encountered at the present time; and that, chiefly on or near the flats.

The following fact, observed by Doctor Trowbridge, deserves to be recorded. In the neighborhood of Buffalo, for three (but not successive) autumns, a local epidemic fever occurred among about twenty families, who drank and otherwise used water from the same spring. It burst out beneath a ledge of limestone, about twenty-five feet below the summit, beyond which, at the distance of a mile, there was a piece of wood-land with a pond, which Doctor Trowbridge supposed to be the source of the spring; for, after rains, its water became turbid. The autumns in which the fever prevailed, were unusually dry. In its symptoms and violence, the disease might have passed for yellow fever. Nine or ten persons died. The surrounding neighborhood remained healthy. The spring was at length abandoned, and the fever did not return. This *seems* to show that the material cause of autumnal fever may be absorbed by water, and then produce its characteristic effects.

In comparing the prevalence and mortality of autumnal fever with the topographical conditions of this locality, we must, I think, admit the restraining influence of climate; for, only a few degrees further south, such a state of surface would inevitably give rise to much more serious visitations of fever, than have generally been experienced at Buffalo.

SECTION XI.

NORTHERN SIDE OF THE ERIE BASIN.

I. Having surveyed the southern slope of this basin, from the influx of Detroit River, to the efflux of Niagara River, at Buffalo, it remains to make an examination of the northern slope. To borrow from anatomy a fanciful illustration, we have traveled round the greater curvature of the expansion of a long natural canal, from the cardiac to the pyloric orifice, and must now survey the lesser curvature.

When treating in the last chapter of the river Thames, we saw that, originating far to the east of Lake St. Clair, it seeks that reservoir by a course nearly parallel to the northern shore of Lake Erie, from which the head-springs of many of its lateral tributaries are but a few miles distant. From the mouth of Detroit River, then, to a point nearly two-thirds of the way to the Niagara outlet, the northern lake-slope is so narrow, that the medical topographer is, in a manner, limited to the coast. Concerning this narrow lacustrine belt, which is more than one hundred and fifty miles in length, I can say but little. It appears to be, like the opposite or southern coast, a flat or terrace-like tract, overspread with a post-tertiary or diluvial deposit, here and there cut through by creeks and rivulets, as they descend to the lake. The lacustrine banks are generally bold, and, from the lashing of the waves against their base, often fall or slide into the water; which keeps the shore soft and muddy. The northern are obviously more exposed to this kind of action than the southern banks, on account of the greater prevalence of southerly than northerly winds. Of the condition of the short estuaries on the side we are examining, I am uninformed; but they may be presumed to resemble those of the smaller streams of the southern shore, in their stagnant waters and swampy borders. Away from the lake, there are occasional cedar swamps. Along this portion of the coast there is no considerable town, and the country is but sparsely inhabited.*

This belt at length widens, partly from the upper part of the river Thames being further from the lake, and in part from a deep indentation at Long Point or Fore-land; formerly a peninsula, but latterly, from the action of the waves, converted into an island. Of this part of the belt, I know but little. Its medical topography may be said, in general terms, to be like that of the narrower belt, further west. Soon after passing Long Point to the east, we arrive at —

II. The Basin of Grand River. — This is the only stream, on the north side of Lake Erie, which deserves to be called a river. The area of its basin may be compared with that of the Cuyahoga, on the opposite side of the lake. Pressing hard on the head or western end of Lake Ontario, Grand River enters Lake Erie, not far from its eastern extremity. Most of the land on this river is rolling. The soil, generally rich enough to support a miscellaneous forest, is also poor enough, in some places, to be covered with pine. The middle and upper parts of Grand River Basin are the best settled portions of Canada West; and may, from their latitude — between 43° and 44° — as well as from their rolling surface and the flourishing state of agriculture, be presumed to suffer but little from autumnal fever. Further down, the basin is inhabited chiefly by Indians of the Iroquois or Six Nations, who removed thither from the State of New York, after the revolutionary war. Lower still, and not more than five miles from the lake, stands —

III. The Village of Dunnville. — According to Doctor Stratton,† the country around this village is heavily wooded, flat, and marshy. The river, fifty yards in width, has its banks so depressed, that in many places they are not a foot above its high-water surface. A dam has been thrown across it, to make a feeder for the Welland Canal, between Lakes Erie and Ontario; which has caused much overflow both above and below it, by preventing the descent of the water, in freshets, and arresting the ascent of that from the lake, when impelled into the estuary of the river by the wind. "The residents in the neighborhood," according to the gentleman just named, "are very subject to marsh fever, every family having several ill in the course of the season."

With this locality we finish the medical topography of the Basin of Lake Erie, and complete that of the group or series of upper and interior lakes;

* Tulloch's Statistical Reports of British Army — Smith's Canad. Gazetteer.

† Edinburgh Journal, No. 147.

but before proceeding to those which lie more than three hundred feet lower, and also much nearer the sea, it may be well to take a few general views.

SECTION XII.

REMARKS ON THE BASIN OF THE UPPER LAKES.

I. Fluctuations and change of level of the Lake-surface.

1. *Tides.* — It has been settled, by the observations of Governor Cass, at the head of Green Bay,* and of Mr. Geo. C. Davies, at Cleveland,† that there are no lunar tides in the upper lakes. This conclusion is in accordance with popular opinion.

2. *Daily fluctuations.* — The surface of the lakes, however, is tranquil in the calmest weather only; and whenever or wherever their shores are visited, the water is seen to be in a state of fluctuation, proportionate to the velocity of the wind. As this is much greater, generally, through the day than at night, especially in the warmer seasons of the year, it follows that the heaping-up of the waters against the shore, will often be higher in one part of the day than another; which seems to have given rise to the mistake, once somewhat prevalent, that there were regular tides. When the wind blows steadily for a certain time in one direction, the surface-waters are impelled from the windward shore, and thrown upon the leeward; leaving the swamps and beaches comparatively dry on one side, while they are submerged more deeply than common on the other. When the water recedes, the decomposable organic matter of the estuaries and lacustrine marshes must, of necessity, be in part floated away; and a greater absorption of deleterious gases may, likewise, be supposed to take place, than if the same water remained in them. A swamp thus acted on will, of course, prove less injurious to health, than one remote from the lake shore, where the water continues unchanged. Some inland marshes, however, are fed by copious springs, and send out streams, whereby their noxious influence may, perhaps, be diminished.

3. *Ground-swells.* — When a strong and unrelaxing wind, not directed to or from the outlet of a lake, has, by blowing several days and nights, driven the water from one side to the other, as from the western to the eastern coast of Michigan, or from the southern to the northern coast of Erie, the surface of the lake becomes an inclined plain, and when the wind ceases, it will return to its horizontal state. This ebbing is generally so gentle as not to be perceived; but occasionally the reflux is in the form of a long and high wave, which in its approach to the shore, has been compared, in appearance, to the fall of water over a mill-dam, when seen from below, and is called a Ground-swell, or Long-swell, by the people who live on the

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* Historical Scientific Sketches of Michigan, p. 194.

† Ohio Geological Reports.

coasts. Two or three of these undulations sometimes follow each other in quick succession. Mr. Butler, who keeps the lighthouse in Fairport, at the mouth of Grand River, in Ohio, informed me that he had seen this swell eight or ten times. In the autumn of 1829, three rapidly succeeded each other, and deluged the lower part of the village, five or six feet deep. There was no wind, and the surface of the lake was smooth, immediately before. At Lockwood, eight miles further down the lake, one of these waves caused an inundation eleven feet deep. They sometimes happen in the winter, when the ice near the shore will be raised up, and fractured, the water being driven through the fissures. The geologists of the State of Michigan have observed these swells in the bays of Lake Superior.

4. *Annual rise and fall of the Lakes.* — The lakes may be regarded as constituting a river, with expansions. Superior, Huron, St. Clair, and Erie, with the intervening straits, represent the main trunk — Michigan, and Green Bay, are tributaries. Below a horizontal plane, touching the bottoms of the straits, the water, of course, is not changed, except so far as it may percolate into the earth, and its place be supplied by rains. It is, then, the surface-water only that flows and constitutes the river. It follows, that if the lake-beds do not leak, the water which flows through the straits must be that which falls within their basins, in the form of rain or snow, *minus* the quantity raised by evaporation, and lost through absorption into the earth. Evaporation, of course, goes on from both the land and water, but its laws are not the same on the two kinds of surface. From the land-surface it takes place, but to a very limited degree, in winter, when the ground is frozen, and in autumn when it is dry; though in summer, when the surface is wet, from the spring rains, it must be active, as the sun's rays, by impinging on solid matters, develop a great deal of heat. Hence, terrestrial evaporation has two *minima* and two *maxima* in every year. The former are the months of August and September, the period of drought, and the months of December, January, February, and March, the period of frost; the evaporation being then reduced to its lowest degree. The *maxima*, or periods of greatest evaporation, are October, after the rains of autumn have fallen on the earth, warmed through the preceding summer, and May, June, and July, when the solstitial sun acts upon a surface watered by the copious rains of spring.

The extremes of variation in the rise of vapor from the lake-surface are much less, and do not correspond, in time, with those of the land. Thus, there is no lack of water throughout the year, except over the margins which become protected by ice in winter; and the difference between the summer and winter temperature of the water, beyond these icy belts, is not so great as on land. Hence, there is one *maximum* of evaporation in July, August, and September, and one *minimum* in January, February, and March; both depending on temperature.

The water which falls upon, or flows into, the lakes, has no progressive or river-current, and merely serves to swell their volume, and raise them to a higher level; but, from their great extent, this cannot take place suddenly.

Lying far in the north, much of the rain which falls on the earth in autumn is converted into ice, and kept from reaching the lake-beds until spring; and all the snow which falls on the ground, from the first of December to the first of April, a period of four months, remains undissolved. The supplies being thus withheld, and evaporation still remaining active, from the long-retained heat of the lake-water, the lacustrine surface sinks to a *minimum*, which, by the month of February, is such that the ice formed near the shore in December, is found to subside, from following the water on which it rests, as the surface lowers. April and May bring their copious rains; the sun dissolves the accumulated ice and snow of the higher latitudes, and the swollen rivers pour their torrents into the lakes, which now begin to rise; and by June or July, a *maximum* is reached. This range of elevation, depending, as it does, on atmospheric causes, is, of course, not uniform, but varies from one to two and a half feet.*

It is worthy of remark, that the great lacustrine river, having its extreme sources in the same region with the Mississippi, has its annual rise at the same season of the year; showing their dependence on a common cause. The effects of their redundance of water, are, however, very different; for, while the floods of the Mississippi overflow its banks, and submerge large districts of alluvial bottom, making fresh deposits of organic matter upon them, the lake-floods are limited to narrow and interrupted tracts of beach, and to the low lands about the mouths of rivers; and when the freshets of both subside, those of the Mississippi leave extensive foul surfaces, to be acted on by the sun; while those of the lakes leave only margins, of inconsiderable extent; which, moreover, are exposed in a very gradual manner. Still further, the Mississippi falls to its *minimum*, with a consequent exposure of the greatest extent of drying surface, in the months of August, September, and October, while the power of the sun is still great in the south; but the *minimum* of lake depression is not reached until February.

5. *Prolonged lake rises.* — Colonel Henry Whiting,† from various traditional and unwritten accounts, and also from observation, has concluded, that the lakes rise gradually, and reach a maximum in seven years, from which they decline; and, at the end of a second septennial period, are found at their lowest level; whence they rise again, to their former elevation, by the close of the third septennial epoch. Thus, in 1800, there was high water; but nothing is known of 1807 or 1808. The years 1814 and 1815, presented high water, 1820 low, and 1828 high. It appears, however, that in 1829, after falling two feet, the water began to rise, and, in 1830, had attained the elevation of 1828; by 1836 it had advanced twenty inches higher; in 1837, it rose seven inches more, and in 1838, twelve inches of greater elevation were attained; immediately after which it began to fall. By these data a gradual rise through a period of seven years, seems to be obscurely indicated; but not a subsidence through the same term. From

* Michigan and Ohio Geological Reports.

† Historical and Scientific Sketches of Michigan: 1834.

the best data extant, taking the depression of 1820 as one extreme, and the elevation of 1838 as the other, the range is six feet.* The researches of Mr. Whittlesey† have brought out nearly the same result. The highest known rise was that of 1838, which, along the St. Clair and Detroit Rivers, destroyed old orchards, and killed forest trees, the annual concentric circles of which exceeded one hundred in number.‡ Of course, an equal rise had not occurred in a century before. The prolonged periodical rises and falls, can only be ascribed to long periods of wet and dry weather, in alternation; and if an accurate account of the quantity of rain and snow, falling annually in various parts of the lake-basin, had been kept since 1800, the meteorological and hydrological conditions would, doubtless, appear at once, in the relation of cause and effect. All who reside on the banks of the Ohio are aware that, from atmospheric causes, the river has periods of two or three years, in which its mean elevation differs from that of other periods. The etiologist, in the atmospheric conditions which give rise to these fluctuations, will see modifying causes of the fevers of autumn.

II. Temperature of the Lakes, and its influences. — The mean annual heat of the surfaces of the different lakes must, of course, vary with the latitude, and is doubtless the same with that of the surface of the ground under corresponding parallels. The extremes of the water-temperature must, however, be much less than those of the surrounding land; for the fluctuations of the movable surface of the water, in summer, mix the warmer with the cooler waters; and, furthermore, the continued evaporation carries off caloric in a latent state, and tends to prevent a high surface-heat. In winter, on the other hand, when a film of ice is formed at the surface, the same fluctuations carry it into warmer water beneath, where it is immediately dissolved; a process that must continue until the whole stratum of agitation approaches the freezing point, and has no more caloric to impart. But the cold of our lake-climates is not great enough to reduce the upper stratum to the freezing point, where the water is deep, and hence the minimum of annual lake-temperature is less than that of the land — cannot, indeed, be down to 32° Fahrenheit. The depth to which the sun's rays can penetrate and warm the pure, transparent water, must be very great. They do not expend their calefacient power on the surface, as they would, if the water were turbid from solid matters suspended in it. The observations already stated, in describing the middle lakes — Michigan and Huron — show that, in the same latitude, the summer temperature is inversely as the depth; and, of course, the winter heat must be directly as the depth. Great bodies of inland water, which for half the year are cooler and for the other half warmer than the soil, cannot fail to exercise an influence on the climate of the surrounding country, which the etiologist cannot overlook. That subject will receive attention in the meteorological portion of this work.

III. Lake Terraces and their effects. — Reference has been repeatedly

* Michigan Geological Reports.

† Geological Reports of Ohio.

‡ Michigan Geological Reports.

made to these terraces, especially as they are found on the south side of Lake Erie. To what extent they exist around the lakes generally I cannot say, but they are nowhere so distinctly developed, I think, as in the vicinity of that lake. They are regarded by the geologists as conclusive evidence, that Erie, and, consequently, all the other lakes, in past times, existed at more than one level above the present surface. These terraces consist of long flat ridges of sand, which prevent the rain-water from flowing off; and they are thus one of the immediate causes of swales, swamps, and sometimes ponds; while the ridges, where the forest is cut down, fill the lower portions of the atmosphere with sand, whenever the wind blows. Superficial ditches, through the swamps and wet grounds, running parallel to the terraces, with deeper cuts at right angles to them, and, consequently, leading to the lake, would redeem all the terraces from their paludal condition, and greatly diminish the prevalence of autumnal fever.

IV. Marginal Lake Forests. — As a general fact, the margins of all the lakes bear heavy forests, even when prairies are found but a few miles from them. These belts of wood-land are valuable to all who live on the southern coasts, as they resist and break the force of the northern winds, which in winter sweep with such velocity over the watery surface. They are, in that respect, like the groves of the prairies of Illinois, and ought to be preserved. Where they surround a permanent lake-swamp, there is still another reason for their preservation.

V. I shall finish the medical topography and hydrography of the upper lakes, with a reference to the observations of Volney.* In 1796, that distinguished French traveler made a visit into the basin of Lake Erie, concerning the fevers of which he says: — "In a journey of two hundred and fifty miles, from Cincinnati to Detroit, begun on the 8th of September, in a company of twenty-five persons, we did not encamp one night, without one, at least, of the party being seized with a periodical fever. At Greenville [on the upper waters of the Great Miami], the head-quarters of the army that had just conquered the country, three hundred persons, from among three hundred and seventy, were sick of fevers. On arriving at Detroit, only three of our party were in health, and on the ensuing day, our commander, Major Swan, and myself were both seized with a malignant fever. This fever annually visits the garrison at Miami Fort [now Maumee City], where it has more than once assumed the form of yellow fever. * * * These periodical fevers are not immediately fatal, but they sensibly enfeeble the constitution, and shorten life. If they seize their victim at the end of October, they are likely to continue all winter, and reduce him to a state of wretched languor and debility. Canada, and the adjacent cold countries, are little subject to them."

In the close of his article, after comparing various localities, he adds: "In the western country I would prefer to live, a hundred years hence, on

* View of the Soil and Climate of the United States: 1804.

the margin of LAKE ERIE, for then it will not as now be infested with fevers." Half the time designated, has already elapsed, and the diminution in autumnal fever is such as to justify the expectation that his prophesy will be fulfilled.

CHAPTER XIV.

THE EASTERN OR ST. LAWRENCE BASIN, CONTINUED.

BASIN OF LAKE ONTARIO.

SECTION I.

HYDROGRAPHICAL OUTLINES.

I. THE BASIN.—The Lake Erie Basin terminates at Buffalo, where the Niagara River has its efflux; for all the water poured into that river by tributary streams, is carried into Lake Ontario. In tracing the outlines of the Ontario Basin, after passing a short distance to the east from Buffalo, we turn to the south, and ascend upon the Appalachian Mountains, to the interlocking sources of the Genesee and Alleghany Rivers, in latitude 42°; then meander eastwardly, to the sources of the Susquehanna; then turn northeastwardly, to the Adirondack Mountains in Northern New York; then northwestwardly into Canada West, until we approach the latitude of 45°; and then curve round, by the south-west, to the place of departure at the Niagara outlet. Thus, the extreme latitudes of this basin, are from a little below 42° to near 45°: its longitudes are from 75° to 80°. As the whole basin is habitable, and the best portions of the State of New York and of Canada West are included in it, no portion of the Eastern Basin is of deeper interest to the etiologist.

II. THE LAKE.—The form of Lake Ontario, is that of an irregularly compressed oval, with pointed extremities. Its length is about one hundred and eighty miles; its mean breadth, thirty-five; its average depth, five hundred feet.* Its longest axis runs nearly east and west. The elevation

* Michigan Geological Reports.

of its surface is two hundred and thirty-two feet above tide-water in the St. Lawrence, and three hundred and thirty-two below the level of Lake Erie. Its mean latitude is about 43° 30′, or nearly a degree and a half north of that Lake. The geological position of Ontario is in the older Silurian rocks; but the country around it abounds in terraces and long parallel ridges, of loose or drifted materials, which bury up much of the rocky strata, and afford abundant evidence that the surface of the lake was once much higher than at present. The outlet of the lake, at its eastern extremity, is the St. Lawrence; on the north side, near that extremity, is the estuary of the River Treat, the only large tributary of that side. On the south, and nearly opposite, is the mouth of Black River; further west, the Oswego, and then the Genesee; but the great supply of water, is that which must make the subject of the next section.

SECTION II.

BASIN OF THE NIAGARA RIVER.

I. The eastern extremity of Lake Erie and the western of Lake Ontario, overlap each other for the distance of about sixty miles. The isthmus between them has a width of thirty or forty miles. It consists of two belts, one of the same elevation with the banks of Lake Erie—another much narrower, and rising but little over the surface of Ontario. The descent from the upper to the lower is abrupt, and as we advance along the precipice from east to west, it approaches Lake Ontario, so as greatly to narrow the lower belt at the head of that lake. The eastern end of this isthmus is traversed by the Niagara River, through which all the superfluous waters of the Upper Lakes make their way into the Lower, by a course nearly north, and through a distance of thirty-five miles.

The tributaries of Niagara River are of inconsiderable size, and but two in number. That on the western side is—

The Chippewa or Welland River, which drains the upper terrace of the isthmus, and enters the Niagara River, half-way between the two lakes. The tract drained by this little river, consists chiefly of slightly rolling table-land, with a substratum of old or Silurian lime and sand stone.* The surface, on the whole, appears to be dry. The Welland Canal, which begins by two heads, one in Lake Erie, and the other in Grand River, a few miles from the lake, traverses this district nearly at right angles to the Chippewa. I have not learned that those who reside near the banks, of the Chippewa or of the Canal, are subject to autumnal fever. On the eastern or opposite side of Niagara River, the chief tributary is—

The Tonawanda, which enters the Niagara a short distance above the Chippewa. A dam, near its mouth, constitutes it a part of the Erie Canal, for fourteen miles, and, at the same time, interferes with the draining of the

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* Smith's Canadian Gazetteer.

extensive swamps, which lie within its basin, not far from the towns of Lockport and Batavia.* Autumnal fever abounds in the neighborhood of these swamps, which lie in the latitude of 43° N., and at an elevation of six hundred feet above the sea.

II. Niagara River and the Falls.—The banks of this river, where it emerges from Lake Erie, are low, its current slow, and its surface always of the same elevation; except when that of the lake is changed, by the action of the winds, or by the periodical rises and falls. Nine miles from Buffalo, the river divides into two channels, which, by their reunion, form Grand Island. At the distance of eighteen miles from the same city, the stream begins to descend a rocky inclined plain, and, by the depression of its beds, higher banks are developed. Here are the Rapids, in the course of which lies Goat Island, a wooded tract, composed of drift or diluvial materials, without swamps. The larger body of water passes on the western side of the island. Both the agitated and foaming torrents reach the precipice, immediately below the island, and plunge over it into the same abyss. The larger falls one hundred and fifty-eight feet—the smaller, one hundred and sixty-seven. From this pool, the depth of which is unknown, the water flows off in a comparatively quiet manner, with mural precipices on each side, which rise two hundred and fifty feet above its surface; but, at the distance of a mile, the Rapids are reproduced; and to them succeeds, from a bend in the ravine, the Whirlpool; whence the stream flows, in a dark and frightful gorge, till between Queenstown and Lewistown it emerges upon the lower belt; and traversing it with a rapid current for seven miles, reaches Lake Ontario, having descended, in the whole, three hundred and thirty-two feet.

All the geologists, who have visited the Niagara, have arrived at one conclusion concerning its cataract, and the chasm through which it flows. The rocks around and beneath the eastern end of Lake Erie (consisting of that limestone which, every where in the Interior Valley, underlies the black Devonian slate), crop out to the north, and constitute, at their termination, the hights of Queenstown and Lewistown, seven miles from the present margin of Lake Ontario. In ancient times these hights made the immediate bank of the lake, and then the Niagara River flowed through its whole length in a shallow trench, like that between Buffalo and Grand Island. Mr. Hall and Mr. Lyell have traced out the pebbly banks of this ancient river, from the Falls to the Hights of Queenstown,† and every visiter may do the same. At the geological epoch referred to, the strait between the two lakes, was like that between Lake Huron and Lake Erie at the present time. As the waters of Ontario subsided, the cataract was formed. The waters then began to fall from the hights upon the new lake-beach. By this fall, they broke up the lower strata, washed away their fragments, and the higher, losing their support, were broken off by the superincumbent weight, and thus the chasm was commenced. If the whole had been of equal density, a regular inclined plain would have been formed; but being of

* New York Geological Reports. † Travels in North America.

unequal hardness, the river necessarily descended by steps. One of these steps is the present cataract. As the rock over which the stream now falls, from its rising to the north, occupied, several miles below, a higher level, the descent must there have been through a greater space than at the present spot; and the longer the recession continues, the shorter will be the descent. Thus, the sublimity of the Falls is lessening with the lapse of time.

As the attractiveness of the spectacle they present is felt and acknowledged by the world, the medical historian is saved the fearful task of attempting to present it, as an inducement to summer traveling by invalids; and may limit himself to the humbler duty of answering the question, whether those who visit this locality in August and September, are in danger of contracting autumnal fever? The immense volumes of spray which are forever ascending, must necessarily render the local atmosphere humid; but, that condition does not seem to generate either intermittents or remittents. In the immediate neighborhood of the cataract there are no swamps; yet they are not very remote; for directly east, the country is level, and within three or four miles, there are swales and limited marshes. Five miles above, to the south-east, Cayuga Creek joins the Niagara. This creek drains a considerable tract of country, which is very flat and wet—known under the name of the Tonawanda Swamp. The shores of the river between the Falls, and this creek, present some marshes, a quarter of a mile in width. The lower end of Grand Island, four miles above the Falls, is flat and wet; and Buckhorn Island, lying near it, has a surface of the same character.

Autumnal fevers, both intermittent and remittent, prevail in the neighborhood of these islands; also near the mouth of Cayuga Creek, and along its banks, from the beginning of August to the end of September; but the village of Niagara Falls is almost entirely exempt from both, though lying to the leeward of the paludal tracts.* The Canada side is equally healthy.

In continuing the medical topography of the Ontario Basin, I propose to proceed eastwardly from the mouth of Niagara River.

SECTION III.

THE LAKE SHORE, FROM NIAGARA RIVER TO GENESEE RIVER.

I. Fort Niagara.—This military post is situated on a point of land, at the junction of Niagara River with the lake. Its site, in N. Lat. 43° 15′, is elevated several feet above the highest waves; and the country around, although remarkably level, is free from swamps or ponds. The returns for six years, give a ratio for intermittents of twenty-four per cent. per annum—for remittents, eleven per cent.† In the third and fourth quarters of the year 1838, a detachment of troops from Florida furnished nearly all the cases of fever; which, consequently, should not be charged upon this post. The

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*Letter of Doctor G. Conger.

†Medical Stat. U. S. A.

tabular returns do not afford exact data for correcting the error from this source; but if it were done, the ratios of intermittents and remittents would be greatly reduced. These outbreaks of intermittent and remittent fever, on coming into a cold climate, deserve to be recorded.

II. Around the whole southern coast of Lake Ontario, there is a bank or terrace, similar to those on the south side of Lake Erie, briefly described in the last chapter. Its development is most striking from the head of the lake, west of Niagara River, round to Sodus Bay, east of Genesee River;* after which, its elevation and distinctness of outline diminish. In several places, instead of a single ridge, the platform widens and is crowned with several low ridges or spines. Its distance from the lake varies from three to eight miles; its elevation also varies in different places, but may be taken at an average of one hundred and ninety feet. In composition it consists of silt, gravel, sand, bowlders, shells, and fragments of wood.† Along the shores of the lake, between the ridge and the water, there are many ponds and marshes, formed by the obstacles which the shingle, or temporary raised beaches of the lake, present, to the discharge of the waters from the northern declivity of the ancient terrace. As new obstructions are forming by the action of the waves, while the same action, or the hand of art, is removing the older, it follows that the paludal character of this coast cannot be successfully obviated. To the south, or rear of the ridge, and between the low crests, where it divides into two or more, there are swales, morasses, and sometimes ponds, which render the terrace unhealthy in autumn. In very wet seasons, Dr. Elwood, of Rochester, has seen the inhabitants more unhealthy than those on the lake shore, although there were no swamps near them. The paludal tracts on or behind the terrace, may be abated by ditching, much easier than those adjacent to the lake; into many of which the waters are driven by the winds, by ground-swells, or by periodical rises; while others, as already stated, have their outlets obstructed with materials rolled against them by the waves.

III. At the mouth of the Genesee River there are tolerably extensive flats, on which the waters of the lake either stand permanently, or which they occasionally overflow. These flats were originally covered with trees, now partly cut down, and abound in aquatic plants. The estuary of the river passes through them. On the left-hand bank of this stream, stands the (comparatively) old and decaying village of CHARLOTTE. In former times, Doctor Backus and Doctor Elwood, of Rochester, saw in this village a great prevalence of autumnal fever, which often assumed a malignant character. When I visited it, in 1847, Doctor Jones, its only physician, was still grappling with the same disease; its type being generally intermittent, and seldom dangerous.

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* New York Geological Reports.

† Ibid

SECTION IV.

BASIN OF GENESEE RIVER.

I. A rapid survey of a part of the lake coast, in the last section, has brought us to the mouth of the Genesee River, which we are now to ascend to its sources in the mountains. The estuary of this river extends five miles from the lake, through a deep gorge of excavation. The navigation is arrested by falls, down which, by three successive leaps, the river descends two hundred and seventy-five feet. This descent is over the terminal out-crop of rocks, which, like those of Niagara, emerge from the south. The lake ridge passes from two to three miles north of Rochester, at a level of about one hundred feet below it, and is intersected by the gorge.

II. ROCHESTER, the largest town of Western New York, except Buffalo, is of such recent settlement, that it was not regarded even as a village of the woods, until 1817. Its latitude is 43° 8′ N.; its distance from the mouth of the Genesee River, seven miles; its elevation above the lake, two hundred and seventy-five,—above the ocean, five hundred and six feet;—which is the average altitude of Cincinnati;—and being just four degrees of latitude apart, they are convenient stations for estimating the influence of latitude on climate, and on the diseases which, directly or indirectly, are produced by it.

The site of Rochester approaches nearly to levelness, and consists of a moderately deep bed of loam, overspreading the same kind of Silurian limestone that is found at Niagara Falls. Originally the surface was swaley, but at this time there are no paludal or pondy tracts. The Genesee River passes through the town from south to north, and has a rocky bed and banks. To obtain water for the Erie Canal, which here crosses the river, and also for milling purposes, a dam was erected across the river, producing a pond for several miles above, which was said to generate a great deal of autumnal fever. Several years afterward, a second dam, which raised the water two feet higher than the first, was constructed, and produced such an increase of autumnal fever, along the banks of the river, that after five years it was torn down.* A mile south of Rochester, there are high deposits of drift, which made part of a long range running parallel to the lake. They are not disposed in terraces but tuberosities, some of which are so elevated that the lake may be seen from their summits.

Doctor Backus and Doctor Elwood came to Rochester in the years 1816 and 1817, when it had not more than three or four hundred inhabitants, and the immediate vicinity of the village was a dense wood. At that time, and for many years afterward, intermittent and remittent fevers, frequently of a malignant character, were exceedingly prevalent. With the extraordinary growth of this beautiful city they have greatly diminished: nevertheless, they have not disappeared; for, as Doctor Ely informed me, sporadic cases of both occur every year, even in the depths of the city.

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* Doctor Ely, of Rochester.

III. The Genesee Flats. — At the distance of twelve or fourteen miles from Rochester, up the river, the celebrated Genesee Flats commence, and extend to Dansville at the mouth of the Canaseraga Creek, a distance of fifty miles. The Genesee River descends into these flats on the western side, seventeen miles below where that creek enters them. The two streams unite, but even when thus augmented, the Genesee River bears no assignable proportion to the breadth of the flats through which it meanders with a sluggish current. They are, in fact, the bottom and bed of a drained lake, of the same class, in form and the direction of its axis, as the existing small lakes, which lie to the east, and discharge their waters into Oswego River. The width of these flats is from two to four miles. On each side, the ground rises by terraces or undulations, to a moderate hight in the north, and a much greater hight at the south, and is deeply overspread with diluvial or post-tertiary deposits, bearing or imbedding innumerable bowlders. By cultivation, the surface of this upland has become dry, with here and there, a swamp or pond. As to the flats themselves, they were originally covered by a dense forest, with tracts of prairie,* nourished by a soil abounding in organic matter; which, from the levelness of the surface, was badly drained, and on which the inundations of the river left ponds and marshes. The elevation of this lake-bed is six hundred feet above the ocean — its mean latitude, a little less than 43°. Its settlement began in the year 1788, but it was not until after the commencement of this century, that immigrants flocked to it, and the work of surface-transformation was undertaken in good earnest. Then it was that autumnal diseases began, and continued to prevail among the settlers so universally, that the expression, 'Genesee Fever,' became a familiar appellation. Doctor Backus and Doctor Elwood, who, as I have said, arrived at the infant village of Rochester in 1816 and 1817, were well-informed of the extraordinary prevalence of autumnal fever in the flats above them; and Doctor Bissell and Doctor Metcalf, who, three years afterward, settled in Geneseo, thirty miles above Rochester, had personally witnessed the annual recurrence of the disease, commencing in the spring, under the ordinary form of vernal intermittents, and continuing until arrested by the frosts of autumn. According to those gentlemen, the tertian type prevailed over all others. Malignant intermittents do not seem to have been frequent, but the remittent form was often unmanageable and fatal. Doctor Hunt, who came in 1825 to Mount Morris, where the Genesee River enters the western side of the flats, informs me, that the people who lived on or near them, including those of the village, were great sufferers from intermittent fever, which he learned had prevailed from the commencement of settlement. It was seldom fatal, and most of the deaths were from the remittent type. Doctor Salsbury, of Avon, on the eastern bank, below Geneseo, had settled there in 1830, when he collected traditionary accounts of the same prevalence. Doctor Lauderdale, who had come to Geneseo in 1840, had,

* New York Medical Reports, Vol. II.

from every source, received the same impression. Such was the effect of disturbing this alluvial surface, so rich in organic matter.

With the progress of settlement and cultivation, although marshes remain and occasional floods occur, a signal amelioration in the state of autumnal health has taken place. All the gentlemen I have named testified to this as a fact; and although both intermittents and remittents continue to return annually, the number of cases, compared with the present population, is so small, that a residence in or around this beautiful and attractive locality, is no longer dreaded.

In 1837 and 1838, the Genesee Canal, from Rochester, was excavated through the flats, to its southern termination at Dansville. The work, as usual, was chiefly performed by unacclimated Irishmen, who, as Doctor Salsbury informed me, suffered much from fever, especially while carrying the excavation through a swamp, on the opposite side of the river from Avon.

IV. Basin of the Genesee, above the Flats. — The whole of this region is composed of hills and valleys, with a gradual rise of the country from six hundred feet, the level of the flats, to more than fifteen hundred, where the sources of the river interlock with those of the Alleghany, Susquehanna and Cataraugus. The summit-level between Black Creek of the Genesee, and Oil Creek of the Alleghany—composed of an extensive mountain swamp—is fourteen hundred and eighty-six feet above the ocean, while other points are still higher; as, for example, Lime Lake, a small body of water, which lies on a portion of the summit-level, between the tributaries of the Genesee, Cataraugus and Alleghany, at an altitude of sixteen hundred and twenty-three feet above the sea.* Geologically, the region we have now entered is composed of Devonian slate, surmounted with sandstone, and capped on its highest points with the conglomerate which emerges from beneath the coal basin of Pennsylvania. As the Genesee makes its way down this hilly declivity, it presents some striking cascades and deep ravines. In other places, it has bottom-lands of considerable width, which are also found along some of its tributaries. Most of the hills have long gentle slopes, and, in some places, are flatted into tracts of table-land. Swamps, chiefly overgrown with hemlock, are frequent, and not limited to the valleys. In the upper part of the basin, the head streams of the Genesee, Cataraugus, Alleghany and Susquehanna, constitute a sort of hydrographical labyrinth, from which the waters make their way into Lake Ontario, Lake Erie, the Gulf of Mexico, and the Chesapeake Bay.

In ascending this mountain slope, although we go directly south, we find that the fevers which prevail on the flats below, and down to the shores of Lake Ontario, get less and less. They prevail more along the Genesee River, and for a short distance up its tributaries, than elsewhere; but at length are almost unknown in every kind of locality, even the most paludal. At the village of Pike, on the banks of the transparent West-Koy, six or eight miles from the Genesee River, and at an elevation (by estimate) of

* New York Geological Reports.

twelve hundred feet above the sea, Doctor Capron, who had resided there twenty-eight years, assured me they were unknown; adding, that the stream abounded in *trout*, a certain sign of exemption from that disease. Cases of remittent fever, however, now and then occur. Doctor Minard, of the same village, confirmed these statements; but informed me that both intermittents and remittents occur, to some extent, near the junction of the West-Koy with the Genesee, and, also, on the corresponding portion of a neighboring tributary, Cold Creek.

The summit-level on which the Genesee, in common with the Alleghany River, originates, lies between 42° and 42° 30′ N. latitude, and has an elevation varying from thirteen hundred to sixteen hundred feet. It is about one degree farther south, and twelve hundred feet higher than the shores of Lake Ontario, between the mouths of the Niagara and the Genesee Rivers. Now, an autumnal fever, especially the intermittent variety, is the principal endemic of those shores, but almost unknown on this platform; and the difference must be ascribed to altitude, as swamps, streams, and organic matter abound in this region.

V. Alpine Summer Residence for Invalids.— When describing the sources of the Alleghany River,* including Chautauque Lake, we were brought, by a southern route, upon the water-shed which we have now ascended from the north. It may be regarded as the great salient terrace, or projecting table-land, of the Appalachian Mountains — that portion which advances farthest to the north-west, from the central axis of the chain — that which approaches nearest to the great lakes. Its tabular yet undulating or hilly surface, results from its resting on a broad out-crop of Devonian shale and sandstone, in which the former greatly predominates. Its rugged and rocky eminences depend on remnants of superincumbent conglomerate, the body of which lies further south, and at a lower level. These spots have a sterile soil, with the tree and shrub vegetation which belong to stony localities, at such an elevation. They make, however, but a limited portion of the whole district, and the extent of fertile land is such, that flourishing towns and villages, productive farms, good summer roads, and cheap and easy means of conveyance, are found in every part. Here, then, are all the requisites for a comfortable and curative *summer residence.* I will mention a few classes of patients, to whom it would be likely to prove beneficial. *First.* Those who are inclined to tubercular consumption, or in whom the disease, although fatally established, is not so far advanced, as to confine them to the house. To which may be added, children affected with scrofula in the external lymphatic ganglia, the skin, and the eyes. *Second.* Those who have had their livers and spleens deranged, in structure or function, or their constitutions otherwise shattered, by repeated attacks of autumnal fever, in low and hot situations. *Third.* Dyspeptics, from any and all causes; hypochondriacs, and those subject to chronic hysteria, or any other form of morbid sensibility.

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* *Ante*, pp. 277, 278, 279.

Every practical physician is aware of the frequent failure of all kinds of medication in these cases, and of the great value of cool and fresh air, in summer, united with active exercise, simple diet, new scenery, and the disuse of medicines, or their use under these favorable circumstances; all of which may be here enjoyed.

From Mayville, at the west end of Chautauque Lake, to Bath and Elmira, on the Chemung River, a branch of the Susquehanna, the distance is more than one hundred miles; from Portage, on the Genesee, to Warren, on the Alleghany, more than fifty; and between these places there are many other interesting villages, which would afford ample opportunities for choice and change. In some of these towns there are respectable, in the remainder, plain but cleanly and comfortable, taverns; the general style of living is adapted, by its simplicity, to the constitutions of the infirm; and the milk of certain portions of the district, as around Chautauque Lake, from the qualities of the grass, is the best within the limits of our Valley. Churches of different protestant denominations are to be found in every village; which has likewise a nucleus of cultivated society; and one or more intelligent physicians, to be consulted in case of need.

The summer climate of this region may be inferred from a few facts. I passed through it in the last week of July and first week of August, and found fires, at night, acceptable. Frost occurs regularly in June and August, and not unfrequently in July. I saw many fields of Indian corn that had been frost-bitten on the night of the third of August. Peaches are scarcely cultivated. The wheat, and even hay harvest, does not take place until August. In passing north to Lake Ontario, I met the scythemen, who had completed the harvest in the country below, advancing south, and mounting on the higher level, to continue their labors.

It may be said that the Virginia Springs are more elevated, and, therefore, better fitted for summer sojourn. But their greater elevation of five hundred feet, would, in the reduction of temperature, only equal a degree of latitude, while this region is four degrees further north. Nor can Saratoga be compared in its summer climate with this mountain platform; for, although a degree further north, it lies twelve hundred feet nearer the level of the sea. The celebrated Springs of Virginia and New York are, moreover, places of amusement for the healthy, not rural retreats for the infirm; to some of whom, it is true, the *mineral waters* might prove beneficial; but all other circumstances would combine to counteract their salutary influence.

The enlightened physician, who conscientiously desires to redeem his patient, for three months of the year, from the deleterious agency of heat and malaria, or to countervail the debilitating effects of a protracted summer on others, in whose lungs the fatal work of tubercular excavation is going on, will, I trust, not regard the business-like details which I have been giving, with disfavor; but patiently read on, until he qualifies himself for overcoming the scruples of such valetudinarians, as may fear or fancy that, in going to the mountain terrace for the summer, they would languish for want of scenes and objects of interest. These are quite as numerous, diversified, and striking as in almost any other portion of the Interior Valley; and I will briefly enumerate the most important.

First. — This region comprehends the great Pine Forest of the Alleghany Mountains. White pine, yellow pine, and hemlock, are the prevailing forest trees: in the barren soils, mingled chiefly with oaks, chestnuts, chinquepins, and whortleberries; — in the fertile, standing side by side, in strange association, with the sugar-tree, elm, beech, walnut, and birch. From this district it is, that pine boards make their way to the lakes, the Chesapeake Bay, and even the Gulf of Mexico. Every water-fall has its saw-mill, every stream its raft, and the ax of the sturdy laborer enlivens the quietest solitudes. *Second.* — A residence in Mayville, at the west end, or Jamestown, at the east end of Chautauque Lake, would afford to the invalid many delightful drives on the serpentine banks of that beautiful sheet of water, elevated seven hundred and twenty-five feet above the level of Lake Erie; and a visit to LIME LAKE, in the adjoining county of Cataraugus, would show him a smaller basin, at the altitude of ten hundred and sixty feet above Lake Erie, or fifty feet above Itasca Lake, in which the Mississippi has its origin. *Third.* — In the same county, near Great Valley Creek, he may ascend a hill, and on its summit, about two thousand feet above the level of the sea, explore a tract of more than one hundred acres, which presents huge masses of conglomerate, so separated and arranged, as to justify the fanciful appellation which it has received, of ROCK-CITY. *Fourth.* — A visit to Portage would afford him a view of the Upper Falls of Genesee River; which, in the course of two miles, by three successive pitches, and some intermediate rapids, sinks four hundred feet; each cascade displaying a peculiar beauty and grandeur; on which, however, the beholder can scarcely fix his attention, because of the emotions of awe and wonder, inspired at finding himself on perpendicular banks, which rise from three to four hundred feet above the surface of the river,* as it winds its way through the gorge. *Fifth.* — Many of the brooks which flow towards the north, abound in speckled trout, while the little lakes and rivers afford opportunities for successful angling, and many wild and rugged tracts invite to hunting. *Sixth.* — Such invalids as might, from taste or the hope of benefit, desire to visit a mineral spring, could, in a single day, or more, according to their position, descend to the Avon Springs in the Flats of the Genesee, twenty miles above Rochester, where they would find excellent accommodations, ample opportunities for bathing, and a copious supply of water, containing, according to Doctor Salsbury, carbonate and muriate of lime, and the sulphate of lime, soda and magnesia, with carbonic acid, nitrogen, and sulphureted hydrogen gases. These springs have been found peculiarly useful in disorders of the digestive organs, chronic rheumatism, and diseases of the skin. *Seventh.* — In a single day, or in two days, the valetudinarian might descend to Buffalo and the Falls of Niagara, whence, if he chose, he could make a voyage to Mackinac or Quebec, and then return to his mountain retreat.

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* New York Geological Reports.

It remains to indicate to the invalid of the West and South, the routes by which this place may be reached. That by way of Pittsburgh, through the Valley of the Alleghany River, is wild and picturesque, but rugged, badly provided, and wearisome. From Rochester, the trip up the Genesee Valley is direct and pleasant. From Buffalo, the ascent to Chautauque Lake can be made in a single day. But of all the routes, that from Dunkirk to Mayville, at the western extremity of Chautauque Lake, is to be preferred. The invalid, once on Lake Erie, may be landed at the port just named, and in a single hour will find himself on the western promontory of the platform, at least eight hundred feet above the surface of the water.

SECTION V.

BASIN OF OSWEGO RIVER, WITH ITS LAKES.

I. This is the region of small lakes. It lies adjoining the Genesee Basin, and extends eastwardly to the sources of the Mohawk River, which flows into the Hudson. It rests, to the north, on Lake Ontario, extending even to its eastern boundary. To the south, it is subtended by the east and west branches of the Susquehanna — penetrating deeply between them. The Appalachian Mountains are here so depressed, that the water-shed between Seneca and Crooked Lakes, and the West Branch of the Susquehanna, where the Chemung Canal crosses it, is only eight hundred and ninety feet above the level of the sea. All the streams of this region, which take their rise in the mountain declivities, terminate in the lakes of the Oswego Basin, and are, therefore, small and short. The outlets of the lakes have their confluence in a common trunk, — the Oswego River; which reaches Lake Ontario, near its eastern extremity. The larger of these lakes, from west to east, are the Canandaigua, Crooked, Seneca, Cayuga, and Oneida. The smaller ones are equally numerous. The whole are long, narrow sheets of water, lying nearly parallel to each other, with their axes north and south. Their elevation above the sea varies from three hundred and eighty-seven to seven hundred and eighteen feet. A deduction of two hundred and thirty-one from these numbers, will give their altitude over Lake Ontario. In depth they vary: — Crooked Lake averages two hundred feet; the greatest depth of Seneca Lake, is five hundred and thirty feet; of Cayuga Lake, three hundred and ninety feet.* These numbers explain why they were not drained, when the Genesee Flats were laid bare. Their beds, in fact, are excavations in the Devonian and Silurian rocks, which appear *in situ*, on the opposite sides of each. Their immediate banks rise from ten to sixty or eighty feet above their surfaces, and the country between them, attains, by terraces or gentle acclivities, an elevation of several hundred feet in the south, but less in the north, where it assumes a more level aspect. At the

* New York Geological Reports.

head of Cayuga lake there is an extensive swamp; but, in general, its margins are dry, till we approach its outlets, when we reach the most extensive paludal region which exists on the southern side of Lake Ontario. The outlet of Canandaigua Lake is into a stream called Mud Creek, which flows eastwardly. From the point of junction, the river takes the name of Clyde, and continues eastward as far as Montezuma, where it receives, through the Seneca outlet, the waters of Crooked, Seneca, and Cayuga Lakes, and then, continuing east, through Cayuga county into Onondaga county, unites with the outlets of Onondaga and Oneida Lakes, with which it forms the Oswego River.* By this channel, the course of which is nearly north-west, all the superfluous waters of fifteen lakes are discharged into Lake Ontario.

II. CAYUGA, MONTEZUMA, AND OTHER MARSHES. — Around the lower end, and along the outlet of each lake, there are broad marshes, or tracts of low alluvion, which suffer inundation when the lakes are swollen by rains, or their waters driven to the north by southerly winds. The Cayuga outlet, which unites with the Seneca, before they unitedly join the Clyde, at Montezuma, has its whole course through a tract of marsh, which even begins in the lake itself. From Montezuma to the Onondaga outlet, twelve or fourteen miles, this marsh continues, preserving a width of two or three miles, and appearing, in summer, like an extensive meadow. There are, moreover, many detached swamps, and tracts of low, wet ground; so that the whole country, from the lower ends of the lakes to the shores of Ontario, between Great and Little Sodus Bays, may be considered as participating largely in a paludal character, while the actual marsh is estimated at sixty thousand acres.† At the present time, after forty years of settlement, the extent of swampy surface within the Oswego Basin is greatly diminished; and many beautiful and flourishing towns, as Canandaigua, Geneva, Auburn, and Syracuse, have sprung up, to attest the salutary influence of cultivation.

The center of this district is in latitude 43°; the elevation of the marshes above the sea about three hundred and fifty feet; that of much of the surrounding country from one hundred to one hundred and fifty feet more. Let us inquire into the past and present state of autumnal health among its inhabitants. In 1792,‡ Doctor Coventry settled on the eastern bank of Seneca Lake, near its outlet, and opposite the new village of Geneva. The autumns of 1793 and 1794 were productive of a great amount of fever, which, however, was not often fatal. In the village of Geneva, there was, in the autumn of one of the early years of its settlement, but a single person not down with fever. "In 1795 no rain fell either in June or July — the waters of the lakes lowered more than a foot — every little inlet became a seat of putrefaction — the heavens seemed on fire, the earth scorched, and the air saturated with pestilence — hogs were found dead in the woods, and the flies swelled, turned white, and laid in handfuls on the floors of the rooms."§ In August, Doctor Coventry visited a family on the east bank of Cayuga Lake, where Aurora

* New York Geological Report. † Ibid.

‡ O'Reilly's Sketches of Rochester, 1838. § Ibid.

now stands. In one room he found the mother a corpse, and in another, the father and two children were down with the fever of which she had expired; the symptoms of which, as described to him, resembled those of yellow fever.

According to Doctor Ludlow,* this region was chiefly settled from 1791 to 1804. From 1800 up to 1813 or 1814, intermittents and remittents prevailed every autumn, in all parts of the country; but after that time, to the date of his publication, in 1823, they were less constant in their annual epidemic recurrence. Of the year 1801, he says: "The diseases of spring and summer months were, principally, intermittent fevers, which prevailed throughout the country; they were of the tertian type. None were exempt from them, except those who had undergone many previous attacks, without having taken any measures to interrupt their course. In September and October, remittents of a mild form appeared."

In 1804, as Mr. Brown† wrote, the "Lake Fever" was of an intermittent type, and exceedingly prevalent, around the marshes of Oneida Lake. In the same year, President Dwight, on a tour through this region, says, in reference to its health: "The diseases which principally prevail here are the ague and fever, intermittents without ague, and bilious remittents. Fever and ague may be considered as nearly universal; almost all the inhabitants being sooner or later seized by it, within a few years after their emigration."

Of the lake country generally, Doctor Reid, of Rochester, remarks, that in in its early settlement, intermittent and remittent fevers prevailed to such an extent, that it was regarded as a 'valley of bones,' a premature burying-place.‡

When at Auburn, Doctor Pitney, who had settled on Cayuga Lake as early as 1808, informed me, that there was then a great prevalence, over the whole of that country, of intermittents, quotidians, tertians, and quartans,—cases of which now and then assumed a malignant character. Remittents prevailed, also, but to a limited degree; they continued to return annually, however, in an undiminished ratio, after intermittents had greatly abated.

It appears from these testimonies, that marshes from three to four hundred feet above the level of the ocean, in latitude 43°, can generate a great annual prevalence of autumnal fever, often assuming a fatal character. We have seen, however, that the swamps of the Chautauque summit, at the hight of fourteen hundred feet, although a degree farther south, are innoxious. Such is the effect of elevation. When speaking of Fort Winnebago, west of Lake Michigan, it was stated, on the authority of our army surgeons, that autumnal fever is almost unknown at that post, though extensive marshes lie contiguous. The latitude of that post is 43° 31′, its altitude eight hundred feet. Shall we ascribe the difference, in autumnal fever, between the two localities, to half a degree of latitude and four or five hundred feet of elevation? There is no other obvious cause, as both were newly-settled regions;

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* Inaug. Disc. 1823; embodying the experience of Doctors McNab, Carter, and Vanderburg, of Geneva, and Doctor Hays, of Canandaigua.

† Med. and Phil. Register, Vol. IV. ‡ O'Reilly's Sketches.

and yet the influence of altitude cannot be greater on the climate, than that of one degree of latitude; whence we may conclude that the Montezuma marshes lie near the northern limits of autumnal fever, at the elevation of three or four hundred feet, and that if, at the same level, they had laid a degree and a half farther north, that is, on the opposite declivity of Lake Ontario, in latitude 44° 30′, they would have been found comparatively harmless.

Let us turn to the influence of settlement, cultivation, and town-building, on the autumnal health of the region under review. All accounts concur in representing it as of the most favorable kind. Both intermittents and remittents, it is true, still occur, but with greatly diminished frequency, in the most insalubrious localities; while they have nearly disappeared from many places where they formerly prevailed every autumn. From General Swift and Professor Webster, who came in 1827 to Geneva, on the high and dry western bank of Seneca Lake (where Doctor Coventry once saw all the inhabitants, except a single person, ill at the same time with fever), I learned, that when they arrived, intermittents still prevailed to some extent, but have almost entirely disappeared; a statement which was confirmed by Doctor Spencer, junior, of the same city, as far as it relates to the rarity of their occurrence at this time. At Auburn, Doctor Pitney assured me, that within the range of his practice, intermittents are incomparably fewer, than in former times; remittents have also diminished in number, but not in the same ratio. From Doctor Briggs, of the same city, whose observations had been continued through a period of sixteen years, I learned that, for ten years after his arrival, in 1831, he did not see a case of intermittent; but since the year 1840, a re-appearauce, to some extent, had taken place. Sporadic remittents have occurred every autumn. The vicinity of the Montezuma swamps, as in early times, is still most infested. At Manlius, Doctor Nims assured me, that the neighborhood of the marshes is much less scourged than formerly, while the disease is almost unknown in more favored localities, where it once existed. By Doctor Hoyt, of Syracuse, the site of which, near the head of Onondaga Lake, was originally a portion of its bed, converted into a white cedar swamp, I learned that, when he arrived, in 1832, there was very little intermittent fever, but latterly it seemed to be increasing, At Salina, two miles down the lake from Syracuse, I was told by Doctor Daniels, who had resided there thirty-two years, that, in former times, autumnal fever was incomparably more prevalent than in latter years. These testimonies may be regarded as sufficient to show the amelioration produced by the hand of art; but the perfect transformation of this region, although an easier task than if it lay farther south, will not be effected for a long time to come — perhaps never.

It is proper to state, that the Erie Canal traverses the swamps, and the whole length of the district which has been described. Of the effects of this excavation on the health of the laborers, after the lapse of nearly thirty years, no reliable information can be obtained; nor am I able to say, whether the excavation or the filling of the canal with water, in other and more salubrious localities, was injurious to the inhabitants along its banks. From Doctor Trowbridge, of Syracuse, I learned, however, that, in the summer and autumn of 1846, intermittents prevailed generally *along* the canal, in its middle and western portions. Although most of the works of art, by which the wilderness is transformed into a settled and cultivated country, contribute, in the end, to its autumnal salubrity, it seems probable that canals do not.

I have treated the lacustrine portion of the Oswego Basin as a whole, but must say something of a few localities.

III. Syracuse and Salina. — The plain on which Syracuse is built, as the surrounding higher lands clearly indicate, was once covered by Onondaga Lake. Its elevation above the sea is four hundred and twenty-five feet. When settlements were commenced, it was still a swamp, overgrown with white cedars. It is now transformed into dry land; but the part which lies nearest the head of the lake is still marshy, and the waters of that part of the lake are shallow. The plain lies to the south-east of the head of the lake. Onondaga Creek enters it from the same direction, and passes through the town, where a dam converts it into a pool. The Erie Canal traverses the center of the town, where it is joined by a canal from the town of Oswego; both of which are expanded into basins, in which a vast number of boats are always to be found. Syracuse is a great salt factory. The water is evaporated by solar heat, from wooden pans, on a vast scale, in the western and southern edge of the town, while to its north-west, beginning among its houses, an immense quantity is boiled down by wood fires.

Salina is situated on the northern side of the lake, two miles north-west of Syracuse, on higher ground, but has the marshy borders of a creek to its north-west. Here, also, immense quantities of salt are manufactured by culinary heat.

The etiological interest connected with these places (as far as autumnal fever is concerned) may be stated in the question, whether the manufacture of salt counteracts the influence of topographical conditions, in producing that form of fever? The effects of the manufacture on the atmosphere are two-fold; *first*, by the liberation of a vast amount of caloric, and the generation of immense volumes of wood-smoke; *second*, the annual escape into the atmosphere of about two millions and a quarter of hogsheads of water in the form of vapor, carrying with it a minute quantity of salt. From all the information I could collect, autumnal fever has not diminished more in this locality than over the region generally, to which it belongs. Yet the testimony of Doctor Daniels and Lovejoy, and of Mr. Woodruff, salt inspector, the last of whom had resided in Salina forty-five years, was, that those who tend the furnaces and boilers, where they are immersed in a hot and humid saline atmosphere, suffer less from intermittent fever than those who, by their occupations, seldom come into the heated atmosphere. In visiting the pans for solar evaporation, on the western bank of Onondaga Creek, where the families of the tenders reside, I was told that their chief disease was intermittent fever. The conclusion from these facts must be, that saline vapor does not counteract the cause of intermittent fever, but that culinary fire — a heated atmosphere —

although it may be humid, does exert a correcting influence. This, perhaps, is one reason why that disease disappears from the central parts of all our towns and cities, and suggests a preventive measure to those who live in marshy places.

IV. OSWEGO.—This town, the largest on the southern coast of Lake Ontario, stands on both sides of the mouth of Oswego River, which approaches the lake with a bolder current than most of its tributaries. The estuary is bordered on both sides by high Silurian sandstone banks, overspread with drift. The town itself is built on two rocky slopes, which rise, on either side, from the water's edge to the hight of one hundred and fifty to two hundred feet. To the north-east, beyond the limits of town-settlement, there is a depression, which appears once to have been a swamp. On the shores of the lake there is no marsh. *Fort Ontario* stands on a bold promontory immediately below the junction of the river with the lake. Marsh-exhalation, at this place, seems to be at a minimum; but the aqueous vapor abounds, for there is a canal, which supplies a vast number of mills with water, taken from the river above; and their agitation of it promotes evaporation: while the ceaseless dashing of the waves of the lake, against the rocky natural and artificial buttresses of the harbor, contributes to the same result. If it be a fact, that paludal streams absorb poisonous gases, and give them out under mechanical agitation, no spot could be found where that liberation would more certainly take place; for this is the *embouchure* of the river which drains all the marshes of the region we have been surveying; and those portions of its waters which escape agitation by the wheels of its numerous mills, are subjected to it as they enter the lake. The latitude of Oswego is about 43° 25′ N.; the elevation of the surface of the river, and that of the lake, two hundred and thirty-one feet above the sea; that of the town ranges from the water's edge up to three hundred feet above. A trading-house was established here, as far back as 1722; and, five years afterwards, a military post. Thus, the settlements here are of a much older date than those in the basin of Oswego River, and the soil has been exposed and stirred for a much longer period. Such a locality, in such a latitude, might be expected to be almost exempt from autumnal fever; but that is not the case; yet its prevalence, on the whole, is less than in the paludal region above — less, for example, than at Syracuse. The years 1828 and 1829 are remembered by Doctor Hart and Doctor Hard as those of its greatest prevalence. The whole country was then affected. For the next fifteen years, it was only sporadic; but from 1844 to 1847, it became more prevalent. The sailors of the port are more subject to the intermittent form — the people of the town to the remittent.

SECTION VI.

BASIN OF BLACK RIVER.

I. The coast of Lake Ontario, from Oswego River round to the St. Lawrence, is loamy, and sufficiently elevated to escape inundation from changes of level in the lake. The only stream of considerable length or volume is Black River, which enters the small bay on which it confers its name, at Sackett's Harbor. The sources of this river interlock with those of streams which flow into Oneida Lake, and into the Mohawk and Hudson Rivers. The Adirondack mountains limit the basin of this river to the east: the tributaries of the St. Lawrence to the north. The utmost sources of Black River are in a primitive formation; but lower ones are found in swamps, which impart to its waters the hue that has suggested its name. Other sources still, are in small lakes, lying on the plain which stretches from the base of the Adirondack Mountains to Lake Ontario and the St. Lawrence River. The river descends to the lake by a series of levels and precipices. Its alluvial grounds, after leaving the mountains, are broad. Its mean latitude is about 43° 45′. This part of the Ontario Basin is thinly peopled, and so little known that I can say nothing of its autumnal fevers.

II. Sackett's Harbor, and Madison Barracks.—Both the town and barracks stand on a thinly covered bed of old Silurian limestone, which, appeared to me nearly identical with that of Cincinnati. Black River enters the bay a short distance to their north. There are no marshes in the vicinity of either. The grounds around the garrison are so level, that they cannot be perfectly drained. The soil is dark, with much clay, and rests on a stratum of limestone, which is from one to three feet below the surface. The nature of the soil, and this superficial calcareous stratum, keep the immediate vicinity of the post, even after ordinary rains, boggy, and favoring terraqueous exhalation. The physical aspect of the surrounding country is waving and undulating. The soil is generally rich.*

The returns from the post, for four years, show a prevalence of intermittent fever to the amount of twenty per cent. per annum, of remittent, three per cent. The last year of these returns was 1838. The next year, 1839, presented more autumnal fever than had been known previously; and the people of the village suffered more than for twenty years before. The fever occurred, also, in the surrounding country.

This is all that I can say of Sackett's Harbor; and with it we close the survey of the southern side of the basin of Lake Ontario, comprising western New York. In proceeding with the northern half, we shall return to the mouth of the Niagara River, and travel round the lake to the outlet of the St. Lawrence, near which stands the town and barracks which have just been noticed.

SECTION VII.

COAST OF LAKE ONTARIO, FROM NIAGARA RIVER TO BURLINGTON BAY.

I. The Mountain ridge through which the Niagara has cut its deep and narrow trough, from the Falls to Queenstown, is distant from the lake about

* Medical Statistics U. S. Army.

seven miles; but fifty miles to the west, at the head of Burlington Bay (the western extremity of the lake) it approaches much nearer. From this highland range many short streams descend, and, traversing the lower belt between it and the lake, pour their torrents into that receptacle by estuaries, in which its agitated waters flow and ebb, and along which there are swampy regions. In general terms it may be said, however, that this portion of the lake coast, till we reach Burlington Bay, is less infested with swamps than some other parts. Its latitude is about 43° 15′ N.; its elevation above the sea, from two hundred and thirty-one to three hundred and fifty feet. In addition to the creeks which have been mentioned, it is traversed by the Welland Canal, which reaches the lake at Port Dalhousie.

II. Niagara and Fort Mississaga. — The Canadian town of Niagara stands near the junction of the Niagara River with Lake Ontario, opposite the American Fort Niagara. The town faces on the river, but the fort is more immediately connected with the lake, over which the bank is so elevated, as not to be inundated by the highest swells of the lake; but the soil is argillaceous, retentive of moisture, and, to the west of the town and fort, there is a considerable extent of swampy ground, particularly along Four Mile Creek.* The army returns do not instruct us as to the prevalence of autumnal fever in this locality; but, as Niagara has been recommended as a place of summer resort, we may conclude that it is but little infested with that disease; and this conclusion is supported by Doctor Melville, who informs me, that, after residing there a year, he had seen none of that fever, and was assured by the inhabitants, that both the village and its neighborhood have been, at all times, remarkably exempt. Niagara has been settled a long time; and to this we may, perhaps, in part, ascribe its alleged autumnal salubrity.

III. St. Catharine's. — This town, the population of which is three thousand five hundred, stands twelve miles west of Niagara, on the Welland Canal.† It belongs to the lower belt or level, but is distant several miles from the lake shore, and has the mountain ridge in its rear. From Doctor Mack, who has resided five years in this place, I learn that autumnal fever is more prevalent in the township of Grantham, of which St. Catharine's is the principal town, than in Niagara. "My experience at this place," says he, "extends through five years, during which, every autumn has been productive, in paludal spots, of a greater or less number of sporadic cases of intermittent and remittent fever, having a typhoid type. Once only, 1846, a mild remittent was epidemic. Between St. Catharine's and Niagara there is a long flat, on and near which there is generally a great deal of autumnal and vernal fever. The settlements along the immediate shores of the lake suffer every year with intermittent and remittent fevers and neuralgias. The Welland Canal, by its leakage, supplies moisture to favor the decomposition of organic matter. In one place it passes through a tamarack swamp, and

* Tulloch's Statistics of the British Army.

† Smith's Canadian Gazetteer.

there the wretched laborers, and other inhabitants, exhibit a pallid and sallow hue of countenance; the females are generally anemic; and the latter end of September and beginning of October, always pass off with great mortality from typhoid affections. This has been the case, even when other parts of the country were quite healthy. Sometimes a violent dysentery prevails among the people living on the mountain ridge, while intermittents and remittents prevail in the lake belt below."

IV. Burlington Bay: Hamilton: Dundas. — According to Doctor Bigsby,* Burlington Bay, constituting the western beak of Lake Ontario, is itself a small lake, communicating with Ontario by a creek running through a high sand reef. A canal has been dug through this bar. Around the extreme termination of the bay, there is an extensive marsh, through which the Desjardins Canal, five miles in length, extends up to the town of Dundas; which stands in a cove, or retreating angle of the mountain ridge. The larger town of Hamilton, which was commenced in the year 1813, lies five miles from Dundas, on the south side of the bay. On account of a swampy margin, the principal part of the town stands a mile from the bay, in rising ground, closely embayed by the mountain ridge, which here ranges at the elevation of one hundred and fifty feet above the town.† To its east there are a few marshy inlets. By Doctor Craigie, of Hamilton, I am informed that Dundas, standing to the windward of the marsh, is healthier in summer and autumn than Hamilton, the sickliest portion of which is the western, which is most exposed to the swamp. By his meteorological observations, it appears that the westerly winds which waft the paludal exhalations from Dundas, and carry them over Hamilton, prevail about three hundred days every year. The type of fever is both intermittent and remittent. The latitude of this locality is about 43° 12′ N.; its elevation above Lake Ontario, from two hundred and thirty-one, up to two hundred and fifty feet. In advancing westwardly from the bay, we soon reach the Basin of Grand River, described in the last chapter.

SECTION VIII.

COAST AND BASIN OF LAKE ONTARIO, FROM BURLINGTON BAY TO THE VALLEY OF THE TRENT.

I. The mountain ridge which presses so close on Burlington Bay, there leaves the lake, and, stretching off to the north, reaches the lower extremity of Georgian Bay, of Lake Huron. West of this ridge is the valley of Grand River of Lake Erie, already described. To the east, as far as the valley of the Trent, more than half the length of Lake Ontario, the northern basin of that lake is reduced to a width of thirty or forty miles; and the little streams which traverse it to the lake, interlock in their origins with the

* Topography and Geology of Lake Ontario.

† Smith's Canadian Gazetteer.

waters of Lake Simcoe, and the south-western tributaries of the Trent. Compared with its counterpart, on the south side of the Lake, which is the basin of Genesee River, this district has but little breadth. Its surface-geology is very remarkable. Starting from the lake shore, and exploring it directly north, the observer passes over a series of post-tertiary steppes or terraces, rising above each other, at unequal hights, and exhibiting various breadths of surface. In all, there are eleven ridges of this kind, and the last and highest is six hundred and eighty feet above Lake Ontario; consequently, nine hundred and eleven above the sea. Beyond the summit-level, an obscure terracing of the same kind leads down to Lake Simcoe, the superfluous waters of which reach Lake Huron through the Severn, by a descent of one hundred and seventy feet, and consequently that lake has an altitude of seven hundred and forty-eight feet above the sea. The remarkable amphitheater of natural benches which has been indicated, is composed of clay, sand, and gravel, supporting granitic bowlders from the north. On many of the terraces there are swamps, but large portions present a sandy soil, overshadowed with pines, which, moreover, are sparsely scattered over every part. Several little rivers, or long creeks, cut through these terraces, and make their way to the lake, of which I may mention the Credit, Holland, Rouge, Humber, and Don. The rapid descent necessary to bring them from so high a level, in so short a distance, appears to have prevented the formation of wide and low bottoms. The latitude of this district extends from 43° 15′ to 44° N.* Excluding, for the present, the lake shore, it may be stated that the region which has been so briefly sketched out, does not suffer much from autumnal diseases. Its being among the best settled portions of Canada West, is, of itself, an evidence in its favor, while its latitude, elevation, and sand-terrace, piny aspect, would suggest the same conclusion. It is not, however, wholly exempt from both intermittents and remittents, which, as Doctor Rees, of Toronto, informed me, occur more or less every year, up to the summit-level of the district, in latitude 44°, and at an elevation of nine hundred feet above the sea.

II. The coast, from Burlington Bay to Toronto, a distance of forty miles, presents nothing very peculiar. Portions of the terrace are sandy, down to the water's edge, and bear pines; but, as Doctor Nicol, of Toronto, informs me, the estuaries of Credit River, the Humber, and several smaller streams, are bordered with swamps, which, in summer and autumn, give origin to intermittent and remittent fevers, which sometimes become epidemic. The mean latitude of this coast is about 43° 20′ N.

III. City of Toronto. — The most populous and important city on the northern, or, indeed, either coast of Lake Ontario, is Toronto, in N. Lat. 43° 39′ 4″, and W. Lon. 79° 21′ 5″. Commencing near the level of the lake, at an elevation of two hundred and thirty-one feet, the plain on which the city is built rises gradually to the hight of one hundred and eight feet. The

* Bigsby: Topography and Geology of Lake Ontario. — Lyell: Travels in North America.—Murray: Canadian Geological Reports. — Smith: Canad. Gaz.

greater portion of the population reside at an elevation of about two hundred and fifty feet above the sea. Above the town, to the west, the immediate bank is higher, and also rises more rapidly from the water. On this part of the terrace, to the south-west of the center of the city, and near the lake, are the fort and barracks. A few miles further, in the same direction, to the summer and autumnal-windward, is the estuary of Etobicoke, a small river. To the north, a second terrace, twenty or thirty feet higher than the first, succeeds, and may be regarded as the second of the series of terraces just described. Adjacent to the city, to the north-east, are the low and swampy bottoms of the River Don; which, however, are of no great extent. Immediately to the east, beyond the mouth of that little river, a sand-bar projects from the shore, to the south, and, curving round by the south-west, terminates in Gibraltar Point, below the town, thus forming the harbor. The surface of this bar rises but little above that of the lake, bears some grass and scattering trees, and has a number of small swamps and ponds, which lie to the south of the city. Several docks project into the harbor, from two to four hundred feet, and present the usual aspect of filth and decaying wood. These accumulations are the greater, because the bar to the east prevents the movement of the waters in that direction by the westerly winds. In examining portions of the town-plat, from which the trees had been recently cut down, I found the ground wet and boggy. Such is the medical topography of Toronto. Its settlement began under the name of Little York, near the close of the last century; but its present estimated population, twenty-five thousand, is the result of a rapid growth within the last few years; so that, in fact, it is still a new town, and the soil of its environs but in the process of transformation. Toronto seems at all times to have been subject to autumnal fever, especially in the intermittent form. More than thirty years ago, the population being about six hundred, when the ponds and swales of the plain on which the town was built were but partially dried up, and the vicinity was still in a state of nature, Doctor John Douglas, of the British army, found intermittent fever prevalent.* Doctor Taylor, surgeon of the 81st Highland regiment, whom I saw in Quebec, was stationed for several years at this place, and during that time, a regiment arrived from England, of which a large proportion suffered from intermittent fever; while of another which came from the West Indies, nearly all escaped that disease; — a fact that deserves to be remembered. As to autumnal fever, at the present time, I learned from Doctor Rees, that both intermittents and remittents are common, especially on, or contiguous to, the low grounds in the vicinity of the city, near the small rivers which have been mentioned. By Doctor Nicol I have been informed, "that both intermittent and remittent fevers are very prevalent in Toronto, and along the neighboring coast, especially near the mouths of the Don, the Etobicoke, the Humber, and the Credit Rivers, where there are extensive marshes. In spring and autumn, nearly one half the cases of disease relieved at the Dispensary, are intermittents. Both

* Edinburgh Med. and Surg. Journal, Vol. XVI.

varieties of autumnal fever occur every year, but are much more prevalent in some years than others. They assume, at times, an epidemic character. Intermittents generally prevail more than remittents. Simple ague is most commonly met with — malignant intermittents are rare. The adynamic, or malignant form of remittent, is common near the mouths of the Humber and the Credit Rivers — in a less degree near that of the Don. It is called by the people the Lake-fever, and is often confounded with typhus. It is the most dangerous form of autumnal fever. On the steppes or terraces north of Toronto, inflammatory intermittents have prevailed to a considerable extent of late, where, formerly, intermittents in any form were by no means very common. In many cases, the inflammatory excitement of some organs masks the true character of the disease."

IV. The Coast, from Toronto to the embouchure of the River Trent. —At the distance of six or eight miles east from Toronto, there commences a tract of highlands, which rise from two hundred and fifty to three hundred feet above the lake. They are composed of drift, or post-tertiary materials, of the same kind with the terraces north of Toronto. Their summits, and the country in their rear, support pines. At their base, near the lake, there are extensive marshes, which extend up every little stream. These high bluffs at length decline into a bank of the same composition, from sixty to eighty feet in hight, which continues eastwardly, and embays the new towns of Port Hope and Coburg, in the vicinities of which, as along the coast generally, there are marshes.* The latitude of this coast is a little below 44°. I regret that I cannot state the extent to which it is infested with autumnal fever.

SECTION IX.

BASIN OF THE TRENT, AND THE BAY OF QUINTE.

I. We have seen that the middle portion of the Southern Basin of Lake Ontario is essentially lacustrine — no less than eleven small lakes discharging their superfluous waters through the Oswego River. It is somewhat remarkable, that the corresponding locality on the opposite or northern side of Ontario, equally abounds in small lakes, which, by their confluence, form a river, the Trent, which, like the Oswego, takes an eastern direction. Unlike that river, however, it does not perforate the side of Ontario, but pours its waters into the head of a long, zigzag appendage of the lake, called the Bay of Quinté, which bears a relation to this lake, very like that of Green Bay to Lake Michigan, or Georgian Bay to Lake Huron. The axis of this bay and of the River Trent is the same, and, continued to the south-east, terminates in Lake Ontario, not far from the efflux of the River St. Lawrence. The same axis prolonged to the north-west, ends in the head or southern extremity of Georgian Bay; showing that the time was, when the latter might

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* Bigsby.

have extended, or sent a river into Lake Ontario, near its lower end. Throughout its whole extent the Basin of the Trent is connected, on the south, with short streams, which flow directly to Lake Ontario; on the north, with the tributaries of Ottawa River, which joins the St. Lawrence near Montreal. The larger of the lakes within the Trent or Quinté Basin, are Skugog, Balsam, Sturgeon, Pigeon, and Rice. The geological basis of this basin is Silurian limestone, and other rocks of that era; but the surface is deeply overspread with drift, or post-tertiary deposits; which, in some places, are arranged into steppes or terraces, but not so distinctly as in the region north of Toronto.

According to Doctor Bigsby,* the River Trent flows rapidly over a shallow and rocky bottom, between high banks, through a beautiful country of steep hills and luxuriant valleys; and, around the Bay of Quinté there are many hills and cliffs; yet, as the same observer states, there are morasses. Some parts of the bay coast are marshy; but it does not appear that the borders of the river and its tributaries, are particularly liable to inundation. Much of the soil is sandy, and supports an intermingled growth of pine and oak.† The whole basin is included between the forty-fourth and forty-fifth parallels of latitude — its mean elevation may be taken at four hundred feet above the sea.

II. North of this basin there are low mountains, with primitive rocks, and the country, up to Hudson's Bay, is in a great degree uninhabited. Of the prevalence of autumnal fever within the basin, I can say but little, for want of information. Its hydrography suggests, that the topographical conditions requisite to the production of that fever in a lower latitude are not wanting; and the only specific account I have obtained, shows that the fever is not absent from the lower and southern part of the basin. Doctor Vanduyk, now of Oswego, New York, who resided ten years in the townships of Ernestown and Thurlow, west of Kingston, and north of the Bay of Quinté, met with that fever every year; and in 1828 it assumed something of an epidemic and even malignant character; for he saw several cases of algid and soporose intermittent. His latitude was 44° 10′— elevation above the sea about two hundred and fifty feet. Compared with Fort Howard, at the head of Green Bay, where the topography is highly favorable to the generation of autumnal fever, and yet it is almost absent, we are led to seek for the causes of the difference between that locality and this. They appear to be two — a difference of half a degree in latitude, that being in 44° 40′; and of three hundred and fifty feet of altitude, that being five hundred and ninety feet above the sea.

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* Phil. Mag. and Ann. of Phil., Vol. V. † Canad. Gaz.

SECTION X.

KINGSTON.

The old French fort, *Frontenac*, now the town of KINGSTON, was established nearly two hundred years ago. It stands in N. Lat. 44° 8′, and W. Lon. 76° 40′, on the north, or left bank of the outlet of Lake Ontario, and, therefore, at the head of the St. Lawrence River, on a slope which rises gradually from the water's edge to the hight of seventy feet, or three hundred above the sea. The basis of this slope is old Silurian limestone, which seems to be almost identical with that which forms the site of Nashville, Tennessee. We are here on the northern margin of the transition formations; for immediately beyond Kingston, primitive rocks, *in situ*, make their appearance; and, stretching in a zone from the north side of Lake Ontario across the St. Lawrence, form the THOUSAND ISLANDS, and terminate in the granitic Adirondack Mountains of New York, west of Lake Champlain. Immediately east of the town lies the small Cataragui Bay, in which a little river of the same name, and the Rideau Canal, from Ottawa River, terminate. The water of this inlet is turbid. In one of its curves or indentations, on the north-eastern side of the town, I found it skirted with low, foul, alluvial ground. In the water there were several decaying docks; and between, or near them, rafts of timber, on which weeds were growing. The water around was evidently the receptacle of a great deal of street, kitchen, and cellar filth, sent out from the numerous small and old houses, inhabited chiefly by poor Irish families, making up the mass of the population in that quarter of the town. This was the only source of insalubrious exhalation which I saw, in connection with the plat of the town; which has but a slight covering of soil, and a declivity of its rocky surface, favorable to cleanliness. On the eastern side of the little bay there is a rocky promontory, one hundred and fifty feet high above the lake, on the extremity of which — once the site of old Fort Frontenac — now stands *Fort Henry*. A mile to the west of the town, a long narrow peninsula, called Point Frederick, stretches into the lake; the ground in the vicinity of which is swampy, and the water around it shallow, stagnant, and muddy, with deposits of decaying vegetation.*

Both intermittent and remittent fevers, but especially the former, prevail annually at Kingston. This is manifest from the returns of the British army; but these diseases prevail less among the troops stationed in Fort Henry, than those which are quartered in the town, on the bank of the little bay which separates them. In a visit to his hospital, on the 8th of September, 1847, with Doctor McIntosh, who had charge of one hundred and twenty artillerists, five of the patients had intermittent fever, contracted in the town; and Doctor McIntosh seemed familiar with the disease, as one annually occurring in Kingston. Doctors Sampson and Robinson, also, testified to the frequent occurrence of both forms of autumnal fever, among the citizens of the place.

* Tullock's Stat. Rep. of the British Army.

Kingston, when compared with Jamestown, near Chautauque Lake, affords an instructive illustration of the influence of altitude in limiting autumnal fever. The topographical conditions, in reference to the production of that fever, are not materially different, and Jamestown is two degrees farther south; yet, from its greater elevation of eleven hundred feet, it is almost entirely exempt.

CHAPTER XV.

THE EASTERN, OR ST. LAWRENCE BASIN, CONCLUDED.

SECTION I.

THE RIVER ST. LAWRENCE, FROM LAKE ONTARIO TO THE ISLAND OF MONTREAL.

I. THE great natural canal, by which the superfluous water of all the lakes, with their confluent streams, over which we have passed, flows off to the Gulf of St. Lawrence, has its broad beginning in the northeastern corner of Lake Ontario, but a short distance below Kingston. For the distance of about sixty miles its current is so gentle that it almost seems a mere arm of the lake. The "*Thousand Islands*" are found in this intermediate section, between the lake and the river proper. They are composed of granite and other primitive rocks. At length, the waters are collected into a single channel, and, moving with increased velocity, present the aspect of a true river; which differs from most others in the Interior Valley, by the uniform elevation of its surface and the equally constant transparency of its waters. Its banks, consisting largely of drift or post-tertiary deposits, are sufficiently developed, and so firm as to be but little acted upon by its gentle current. In many places the stream divides and incloses portions of the bank, in the form of islands, which of course are not subject to inundation. The lower half of the distance to Montreal Island, affords many bold and impetuous rapids; and above the island there are expansions of the stream, which have received the names of Lake St. Francis and Lake St. Louis; the shores of which, in some places, are low, alluvial, and marshy; while along the river, generally, wherever a tributary enters, there is more or less of swamp. The affluent streams, however, are not numerous, and the whole are small.

II. Topography of the Country on the Southern side of this section of the St. Lawrence.—The basin or valley of the St. Lawrence, on its southern side, has no great breadth, and is terminated by the Adirondack Mountains of Northern New York, which may be seen, as blue mounds in the horizon, in descending the river. These mountains constitute the culminating dome of the streams which flow into the St. Lawrence, on the north; into Lake Champlain, on the east; into the Hudson and Mohawk, on the south; and into Lake Ontario, on the west. The same mountains have numerous small lakes, at the hight of fifteen or eighteen hundred feet.* The streams which descend from them to the St. Lawrence are cold, transparent, and inhabited by trout. The principal are the Oswegatchie, Indian, Racket, Grass, St. Regis, and Salmon. Even these, however, are of moderate length and volume; for the belt of country which they traverse is narrow, compared with its length. They abound in falls and rapids. Some of them originate in swamps, which impart to their waters a darkish hue. The lower and flatter portions of this region are less lacustrine than the higher. Indian River expands into Black Lake near Ogdensburg, and then joins the Oswegatchie. Near the St. Lawrence the general aspect of this region is level, or terrace-like, and rolling, with tracts of woodless plain. It then becomes hilly, and at last mountainous. Its lower or northern extremity, constituting a sort of peninsula between the St. Lawrence and Lake Champlain, is chiefly a dead level, and but little elevated above the water. The underlying rock of this tract, in its southern part, is granite,—near the river, old quartzoze sandstone, and other transition rocks. The surface abounds in drift, or post-tertiary deposits, supporting granitic bowlders, which lie at the base of those mountains; from which, in the opinion of Mr. Hall,† the erratic blocks of primitive rock, found in the south-west, down to the banks of the Ohio, were transported.

III. Ogdensburg.—This is the most important town of the region we are surveying. Its position is immediately below or east of the mouth of the Oswegatchie River, on a high bank of the St. Lawrence, overspread with, or composed of, drift, resting on the oldest Silurian rocks, from which, near the town, the water falls, in reaching the St. Lawrence. On the opposite or western side of this little river, the bank, by two terraces, attains even a greater elevation than the plain on which the town is built, and has the same composition. Near the junction of the two rivers are several acres of alluvial ground, part of which is perpetually covered with water, while the whole is liable to inundation from floods in the Oswegatchie. A short distance from its mouth, there is a dam, creating a pool, in which a vast number of 'saw-logs,' floated from the interior, are constantly accumulated. From this pond, mill-races pass through the alluvial ground.

Doctor Sherman came to Ogdensburg in 1825, when it was still a newly-settled locality, and found autumnal fever prevailing. In the following year it was universal, extending to both sides of the St. Lawrence, up and down

* New York Geological Reports.

† Geological Report of the State of New York; Second and Fourth.

the river; also, around Black Lake, which lies a few miles from the St. Lawrence, and along all the small streams,—invading, in a mitigated degree, even the highest and dryest ridges and terraces. In 1827 and 1828 it recurred, but with less violence; and then ceased until 1835 or 1836, when a slight invasion was experienced. Again it disappeared until 1845, when cases occurred, followed, in the two next years, by others. Its type was both intermittent and remittent — in the recent invasions the remittent form predominating. The testimony of Doctor Laughlin, who arrived in 1835, corroborates, as far as it goes back, that of Doctor Sherman. In 1846, he saw it occurring in surrounding localities, where it was said not to have appeared before. He had formerly lived twenty miles south-east of the St. Lawrence, in a broken country, where the fever did not occur.

In comparing this locality with Green Bay, the latitude of both being 44° 40′ N., we find the topographical condition of the latter decidedly more fitted to produce autumnal fever than that of the former; and yet the disease has prevailed to a far greater extent here than there; a difference which may be referred, perhaps, to the difference of three hundred and fifty feet in their altitude. If we extend the comparison to Fort Winnebago, one degree and ten minutes south of Ogdensburg, but five hundred and seventy-five feet higher, the evidence is still more conclusive; for, while the topographical circumstances at that post are more favorable to the origination of the fever, its prevalence is less. Again, when we compare Fort Snelling, at the junction of the St. Peter's and the Mississippi, we have evidence of the same kind. That post is only thirteen minutes north of Ogdensburg, but five hundred and twenty feet more elevated, and autumnal fever occurs in the most limited degree only, notwithstanding the topography might favor its production.

Of other localities within the region, the outlines of which have been sketched, I cannot speak, for want of information.

IV. The Northern bank of the St. Lawrence, from the Lake to Montreal.—This is a long and very narrow belt, traversed by short and inconsiderable streams. Narrow as it is, however, it embraces a number of small lakes. The immediate bank of the upper part of this section of the river is high and dry, and does not, like the banks of the Ohio, decline from its margin, but becomes, in many places at least, still higher, as we go back from the river. Its geological constitution is the same as that of the region just described.

V. Prescott.—The town of Prescott stands opposite Ogdensburg, in N. Lat. about 44° 45′. It is built on a limestone slope, its site inclining to the river, and well-drained. A mile in its rear there is a swamp now partly cultivated. Doctor Scott, who had resided many years in the town, declared to me, that intermittent fever had not originated either in the town or around the swamp. According to Doctor Sherman, of Ogdensburg, however, cases occurred here in 1826, when the disease assumed an epidemic character at Ogdensburg. Remittent fever, Doctor Scott informed me, now and then presents itself.

The first rapids of the St. Lawrence occur four or five miles below Prescott and Ogdensburg.

SECTION II.

BASIN OF OTTAWA RIVER.

I. Ottawa River, the largest tributary of the St. Lawrence, has its principal sources about N. Lat. 48° 30′, and W. Lon. 76°, where they interlock with those of the lake and river Abbitibbe, of Hudson Bay. At first, it runs west of south for two hundred and fifty miles, when it enters Lake Temiscaming; whence it sweeps to the south-east, through a region of lakes, ponds, swamps, and forests; expanding, contracting, dividing, re-uniting, moving quietly on long levels, and descending in cataracts or rapids, until it joins the St. Lawrence at Montreal Island, after running a course of between six and seven hundred miles. It receives the waters of many tributaries, both from the north and the south, and may be said, in general terms, to drain all the northern and middle portions of the region between Montreal and Lake Superior, up to the waters of Hudson Bay. Its basin comprehends about eighty thousand square miles.* Above Lake Temiscaming, situate on an expansion of the river called Grand Lac, the Hudson Bay Company have a post; and another on that lake in N. Lat. 47° 19′, and W. Lon. 79° 31′, at the altitude of six hundred and thirty feet above the sea.

The Ottawa is to the St. Lawrence, in one respect, what the Alleghany is to the Ohio. It passes through pine forests, and most of the people who inhabit or labor on its banks, are engaged in the lumber trade. For about one-third of the distance from its mouth to its source — that is, as far up as the mouth of its largest tributary, the Madawaska, which flows from the south-west — it passes through a country tolerably well settled; beyond that point the settlements are thin, and, at length, cease altogether. In general, its banks are low, broad, alluvial, and subject to inundation.†

II. Bytown, the only important town within the Ottawa Basin, stands on the right bank of the river, at the distance of one hundred and five miles from its mouth. Adjoining the town there is a garrisoned fort. The elevation of the river, below the falls, which are near the town, is one hundred and eight feet above the sea. There are here, in fact, two towns — the older, on lower ground, and the newer, a mile farther up the river, on a higher terrace. The fort stands between them, and a canal to Lake Ontario starts from between them. The population of Bytown is seven thousand. About one-third of the people of the lower town are Canadian French, the remainder chiefly Irish.‡ As this locality is near the latitude of 45° 30′ N., I regret not being able to state in what degree it is affected by autumnal fever; nor

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* Canadian Geolog. Survey.

† Martin's Brit. Col.

‡ Smith's Canad. Gaz.

am I informed to what extent that fever prevails along the river above the town.

III. THE RIDEAU CANAL. — This canal, which connects Bytown with Kingston, is largely a slack-water improvement of Rideau River, passing through the lake of that name and some others. "Thousands of acres of land have been flooded by the damming of the river to form the canal, and immense quantities of timber have been consequently destroyed. Great numbers of trees are still standing, dead, and surrounded by water, and give those portions of the banks of the canal a decayed, deserted, miserable appearance."* From Doctor Nichol, of Perth, I learn that the region near the middle portion of this canal abounds in swamps and small lakes, with a prevailing sterility of surface. Its latitude is about 45°. Intermittent fever occurs every summer, and has been epidemic twice, in the years 1820 and 1847. In the former, the healthy were not in sufficient number to look after the sick: in the latter, which occurred in harvest time, the prevalence of the fever was such as to interfere with the labors of the season. This is the first locality, in the latitude of 45°, in which we have met with such epidemics. Its elevation above the sea is probably about three hundred feet. Remittent fever is exceedingly rare, especially in its malignant or congestive form.

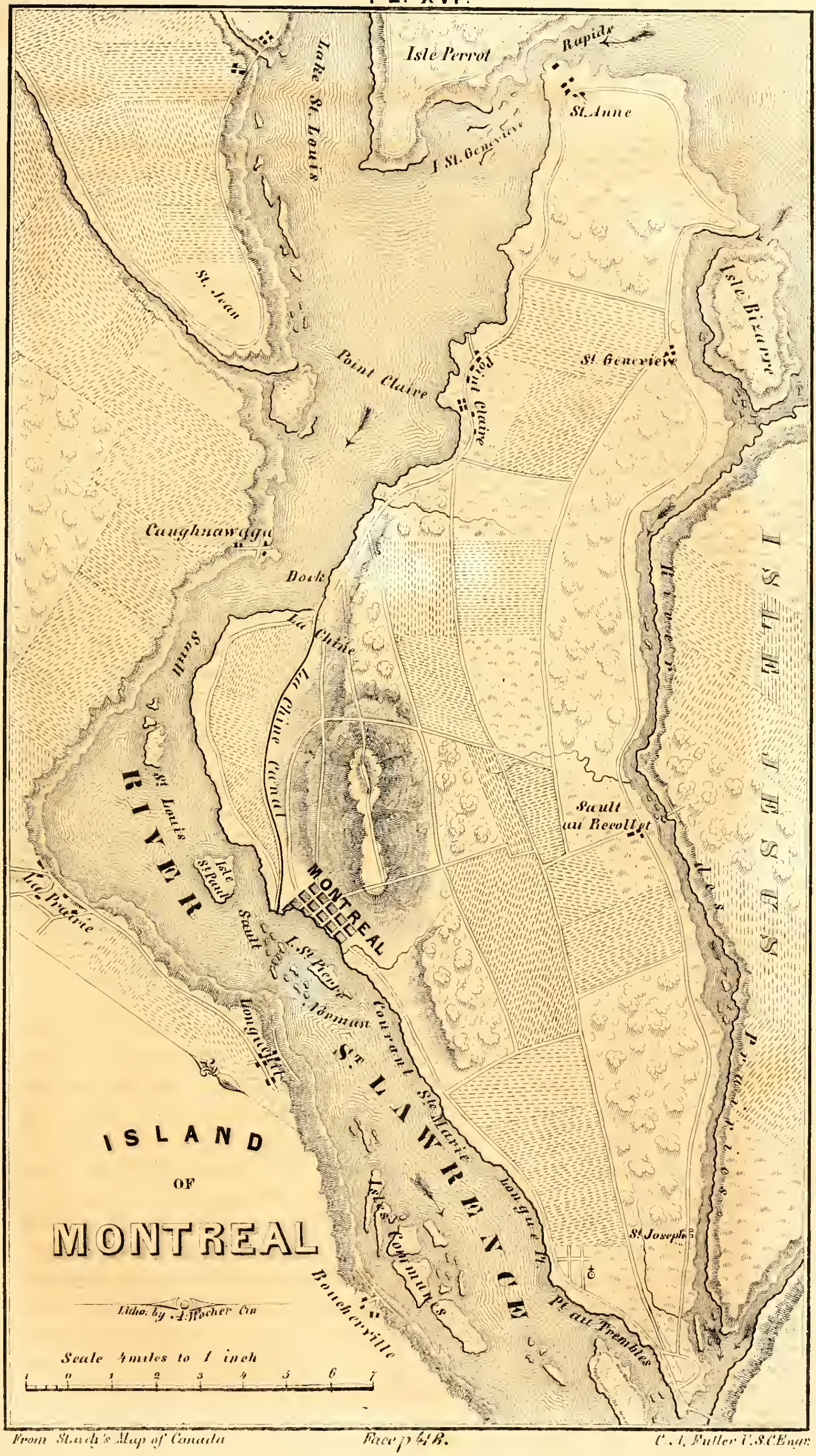
IV. THE OTTAWA RIVER, BELOW BYTOWN.—Doctor McCullough, of Montreal, who resided ten years on the banks of this portion of the Ottawa, assured me that intermittents and remittents were unknown along the river, for a distance of more than thirty miles, over which his observations extended. Nevertheless, Doctor Calder, who resides at Lachine, Montreal Island, informed me that he had seen cases of intermittents from that river, but could not say in what part of its basin they were contracted.

SECTION III.

ISLAND AND CITY OF MONTREAL.

I. THE ISLAND. — The map of the Island of Montreal (*Pl. XVI*) will render an extended description unnecessary. Much of its surface presents a low platform of pebbles, and other transported materials, resting on transition limestone, and covered with productive soil, greatly incumbered, in many parts, with erratic blocks of primitive rock. There are, however, ridges, or *coteaux*, composed of transported materials, which rise to the hight of one hundred feet, or more, above the general level of the island. A plateau of this kind traverses the southern part of the island, running south-west and north-east, from near Lachine to the center of the city of Montreal. That part which penetrates the city, is, however, but a kind of isthmus, or narrow cape; for an excavation has been made by ancient currents, so as to form a hollow or valley through the north-west part of the city. In this depression

* Smith's Canadian Gaz.



From Stach's Map of Canada   Face p. 418.   C. A. Fuller U.S.C.Engr.

a small wet-weather stream still flows, and in former times there was, along it, a considerable extent of swampy ground, rendered foul by filth from the town. In looking from this terrace between Montreal and Lachine, to the south upon the lower platform through which a canal passes, several spots appear to be swaly. High diluvial terraces of the same kind are found on other parts of the island, but its coasts generally are low and flat, and those of its western extremity, above Lachine, are sometimes overflowed by floods in Ottawa River, or from the force of westerly winds acting on the waters of the Lake St. Louis, an expansion of the St. Lawrence. Lastly, in the rear of the city, stands the noted mountain of Montreal, the hight of which according to Captain Bayfield * is seven hundred and sixty feet above the river, and seven hundred and seventy-eight above the sea. This mountain is composed, in its lower parts, of old Silurian limestone, through which a great mass of green stone has been projected, and forms its upper part, which is divided into two summits.†

Lachine is an old French village, formerly the emporium of the fur-traders and *voyageurs*. It stands on a low rocky shore, nine miles west of the city; where there is an extensive basin to supply the canal, the bottom of which presents strata, changed from a horizontal to a nearly vertical position; an effect produced, no doubt, by the same force which threw up the greenstone of the mountain. Opposite the island, are the last rapids of the St. Lawrence.

II. MONTREAL.—The city stands on the south side of the island, in Lat. 45° 31′ N., and Lon. 73° 34′ W. It was settled by the French as far back as 1642; and came into the possession of Great Britain one hundred and twenty-one years afterward. Its population may be estimated at thirty-five thousand,—composed of Canadian-French, Irish, English, and Scotch, with a few from Germany and the United States.

Montreal is built on two terraces. The lower, lying next the river, presents at its margin the finest permanent wharves, of any city in the Interior Valley. The upper, which is not many feet higher, has but little breadth, and in its rear there is a depression or hollow, in which a sluggish brook was originally skirted with narrow swamps. Immediately beyond it is the base of the mountain. The canal from Lachine enters the St. Lawrence through the edge of the city, to its south. For a long time after the settlement on this spot, much of the island,—even places within the limits of the town,—had not yet been subjected to those transformations which cultivation and public hygienic labors effect. Thus, within the memory of the present inhabitants, as Professors Holmes and Hall informed me, the hollow, of which I have spoken, then in the rear of the town, but now almost in the heart of the city, was in a condition which occasioned intermittent fever; a disease which at the present time is nearly unknown on the island. In traversing the fever wards of the *Montreal General Hospital*, with Professor Hall, on the 1st of September, 1847, I met, among the cases of continued

* Lyell's Travels. † Ibid.

fever, one which seemed to have an intermittent type, but found by inquiry, that the patient had lately sojourned at Oswego, in the State of New York. In examining the summer and autumnal reports of this Hospital, as published in the *British American Journal*, I find the same absence of this form of disease: one or two cases of intermittent — sixty, eighty, or ninety, of continued fever. At Lachine, some of the old inhabitants assured me that they never had intermittent fever, except when it was contracted up the St. Lawrence. Doctor Calder, in three years, had seen no case originating in that village. On the whole, we find that a paludal tract, such as has been described, may, in the latitude of 45° 30′, when near the level of the sea, give origin to intermittent fever. The transformation of that tract has nearly annihilated that type of autumnal disease; but remittents, tending strongly to a continued form, still occasionally appear.

SECTION IV.

REGION SOUTH AND NORTH OF THE ST. LAWRENCE, BETWEEN MONTREAL AND QUEBEC.

I. Basin of Lake Champlain.— The long, deep, and narrow trough of Lake Champlain, lies nearly north and south, between the Adirondack Mountains of New York, on the west, and the Green Mountains, of Vermont, on the east. Its head, or southern extremity, is found about latitude 43° 30′ N.,— its lower or northern end, a little above 45°, where it terminates in the Richelieu or Sorelle River. The course of this river is, also, to the north; which causes it to approach the St. Lawrence very obliquely— the direction of that river, below as above Montreal, being north-east. Their junction is at Fort Henry, below Montreal, a little above the latitude of 46°. The elevation of the surface of this lake, the lowest of any considerable size in the eastern or St. Lawrence basin, is ninety-three feet above the ocean, and one hundred and thirty-eight below Lake Ontario. Some portions of the chasm which constitutes its bed, are five hundred feet beneath the level of the sea. Lake George, having an axis nearly parallel to that of Champlain, is connected with its southern portion, and extends the Champlain basin down to the latitude of 43° 25′,* which is the spot where the Great Interior Valley approaches nearest to the tide-water of the Atlantic Ocean, and where we find the greatest depression of the water-shed which divides them from each other. Throughout the southern half of Lake Champlain, on its western side, the Adirondacks press so close upon it, as greatly to limit its basin. The first considerable river originating on the northern slopes of those mountains, is the Au Sable; the next is the Saranac, which enters the lake at Plattsburg. On the eastern side, beginning near the head of the lake, and traveling down, we meet with Poultney, Otter,

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* New York Geological Reports.

Onion, and Mississique, which have their extreme sources on the flanks or among the summits of the Green Mountains of Vermont, where they interlock with tributaries of the Connecticut River. The Champlain basin is much wider on this side than the other. The three principal towns on Lake Champlain are Whitehall and Plattsburgh, in the State of New York, and Burlington, in Vermont. Of their liability to autumnal fever, or of its prevalence on the intervening lake shores, I am uninformed.

II. Valley of the Richelieu.— The outlet of Lake Champlain, commencing in latitude 45°, terminates in the St. Lawrence, forty-five miles below Montreal, near latitude 46°; thus traversing a degree of latitude, by a course eighty miles in length, and varying a little east of north. The narrow neck of land between Richelieu and the river into which it pours the superfluous waters of Lake Champlain, is mostly a dead level, with a surface rising but a few feet above the St. Lawrence. On the opposite or eastern side, the aspect is much the same. The country on each side is fertile, and has long been settled and cultivated. Something might be said, if I had adequate materials, of a few points: The Isle aux Noix, twelve miles from the lake,— the town of St. Johns, ten miles further down,— that of Chambly a few miles below, and that of Sorelle, at the junction of this river with the St. Lawrence.

Isle aux Noix.— This islet is a quarter of a mile wide, and three quarters long. Its surface, composed of vegetable mold and alluvion, rises only four or five feet above the ordinary surface of the river, and much of it, therefore, is liable to inundation, in the spring and in wet seasons. Much of the surrounding country to some distance from the river is low, swampy, and covered with cedar, hemlock, and pine. This island is the site of a British post.* The Army Statistics do not tell us whether intermittent fever prevails in this locality; but I am informed by Doctor G. W. Douglas, Quarantine Physician, at Gros Isle, and Professor Hall, of Montreal, that it does.

Chambly.— I cannot give the medical topography of this spot, but Doctor Kimber, after a residence of twenty-seven years, informs me, that cases of autumnal fever are extremely rare; and that when intermittents do occur, they are in persons who contracted them on the banks of Lake Champlain. He has never seen an intermittent that was generated in Chambly, or its neighborhood. Remittents are met with, now and then, but are almost limited to individuals affected with sub-acute gastritis, or some other chronic ailment, or have been poorly fed and lodged.

III. The 'Eastern Townships.'— The region directly east of the Richelieu has received this appellation. It is watered by several rivers, all of which, like that just mentioned, flow nearly from south to north,— having their sources at the base, or on the northern escarpments of the Green and White Mountains of Vermont, New Hampshire, and Maine. The most important of these streams, beginning with that contiguous to the Richelieu,

* Tulloch's Statistical Reports of the British Army.

are the Yamaska, which enters the Lake St. Peter, an expansion of the St. Lawrence; the St. Francis, which originates largely in Lake Memphremagog, and joins the St. Peter below the last; the Nicollet, which enters the same lake, further down; the Becancour, which joins the St. Lawrence still further down; lastly, the Chaudiere, which throws its waters to the level of that river by a remarkable cataract, in the neighborhood of Quebec. Most of this region lies between the latitudes of 45° and 46° 30′ N. and the longitudes of 70° and 73° W. The surface of this region, generally, if we exclude the mountains which bound it to the south, is composed of a rich mold, resting on loam, with a sub-stratum of gravel, below which are formations of primitive and transition rocks. In its southern part there are a number of small lakes, and along many of the streams there are tracts of alluvial bottom, some of which are prairies. In their descent from the mountain escarpments, the rivers abound in falls and rapids, but as they advance to the St. Lawrence their currents become sluggish, from the prevailing flatness of the country, which, however, is relieved by some insulated mountains.

The whole region was originally covered with various kinds of forest trees; but as a belt near the St. Lawrence was settled by the French, nearly two hundred years since, it now exhibits the aspect of an old country; up some of the rivers, these settlements also extend for some distance, but the greater part of the eastern townships were settled by emigrants from Great Britain at a much later date; and large portions are still covered with forest.*

IV. HATLEY.— I can say but little of the special medical topography of this region, having only seen it from the St. Lawrence. The town of Hatley, high up the St. Francis River, near Lake Memphremagog, is situate in Lat. 45° 12′ N. From Doctor Gilbert, one of its physicians, I learn that "Autumnal fevers both intermittent and remittent are unknown within fifty miles of the place, except in persons arriving from the west." I have to regret that no notice of the topography of the region is included in his communication.

V. SHORES OF LAKE ST. PETER. — I am indebted to Doctor Von Iffland, now of Beauport, near Quebec, for the following facts: About ten miles below the mouth of the river Richelieu, on the south side of Lake St. Peter, there is a large tract of low marshy ground, frequently covered by inundations from the St. Lawrence, as well as by floods from heavy rains. There is in the soil abundance of organic matters. About the end of August, almost every year, from 1823 to 1826, when he resided there, remittent fever made its appearance, prevailing more or less, according to the character of the preceding spring and summer. When the spring was dry and the summer hot, so as to evaporate the waters of the ditches and marshes to dryness, the fever became epidemic, and continued until the copious rains of autumn re-filled those receptacles. Nearly all the cases which happened after frost occurred, took on the form of intermittents.

* Martin: History of the British Colonies. Vol. III.

About five miles from this locality, to its south-west, there is a stream called Third River, which was choked up with decaying logs and brush, so that in freshets it overspread the adjacent level lands, and generated marshes. About the year 1823, five or six families settled in log cabins near the river at this spot, and began clearing the forest. In the first autumn every member of all the families sickened with intermittent fever; but after the lapse of three years, when the necessary transformations were effected, the disease ceased so entirely that Doctor Von Iffland thinks no case has occurred since 1826. The latitude of this spot is 46° N.— its altitude but a few feet above the level of the sea.

VI. The Townships generally.— Doctor Douglas, of Gros Isle, writes to me as follows: — "I have been informed by the old settlers in the eastern townships, that thirty years since (1818) intermittent fever was a common disease in the neighborhood of lakes and low grounds, though now it is unknown."

I have given all the facts I have been able to collect, relative to autumnal fever, on the south-east side of that portion of the St. Lawrence, which extends from Montreal to Quebec, and from the forty-fifth to near the forty-seventh parallel of latitude, at an elevation but little above the tide-water in the river. The conclusion from the whole seems to be, that in the progress of settlement, clearing, and first cultivation, both intermittents and remittents prevailed, but have ceased; although topographical causes remain which would generate them, even to an epidemic degree, in a more southern climate. We must now pass to the north side of the river.

VII. North side of the St. Lawrence.— The immediate bank of the river on its left-hand side, from Montreal until we come within twelve or fifteen miles of Quebec, like that of the right-hand side, is so depressed as to be but a few feet above the surface of the river. The low and level region on this side is, however, much more limited than on the other. By terrace-like rises it becomes elevated into mountains, at the distance of thirty or forty miles. Of this region, Doctor Gilmour, of the town of Three Rivers, remarks,— "This part of Lower Canada is generally sandy; some districts are well watered by beautiful rivers; the inhabitants very poor, but healthy and long-lived. Intermittent and remittent fevers are scarcely known; I have never seen any but imported cases, or such as had suffered from previous attacks contracted out of the lower province." The region within which these observations were made stretches obliquely from the forty-sixth to the forty-seventh parallel, and, near the St. Lawrence, rises but a few feet above the level of the sea.

The largest river which traverses this region is the St. Maurice, whose *embouchure* is formed into a delta, by two small islands which divide it into three channels, immediately above which is the old French town *Trois Rivieres*, now the '*Three Rivers*' just mentioned. Its latitude is about 46° 22′ N. — its position equi-distant between Montreal and Quebec.

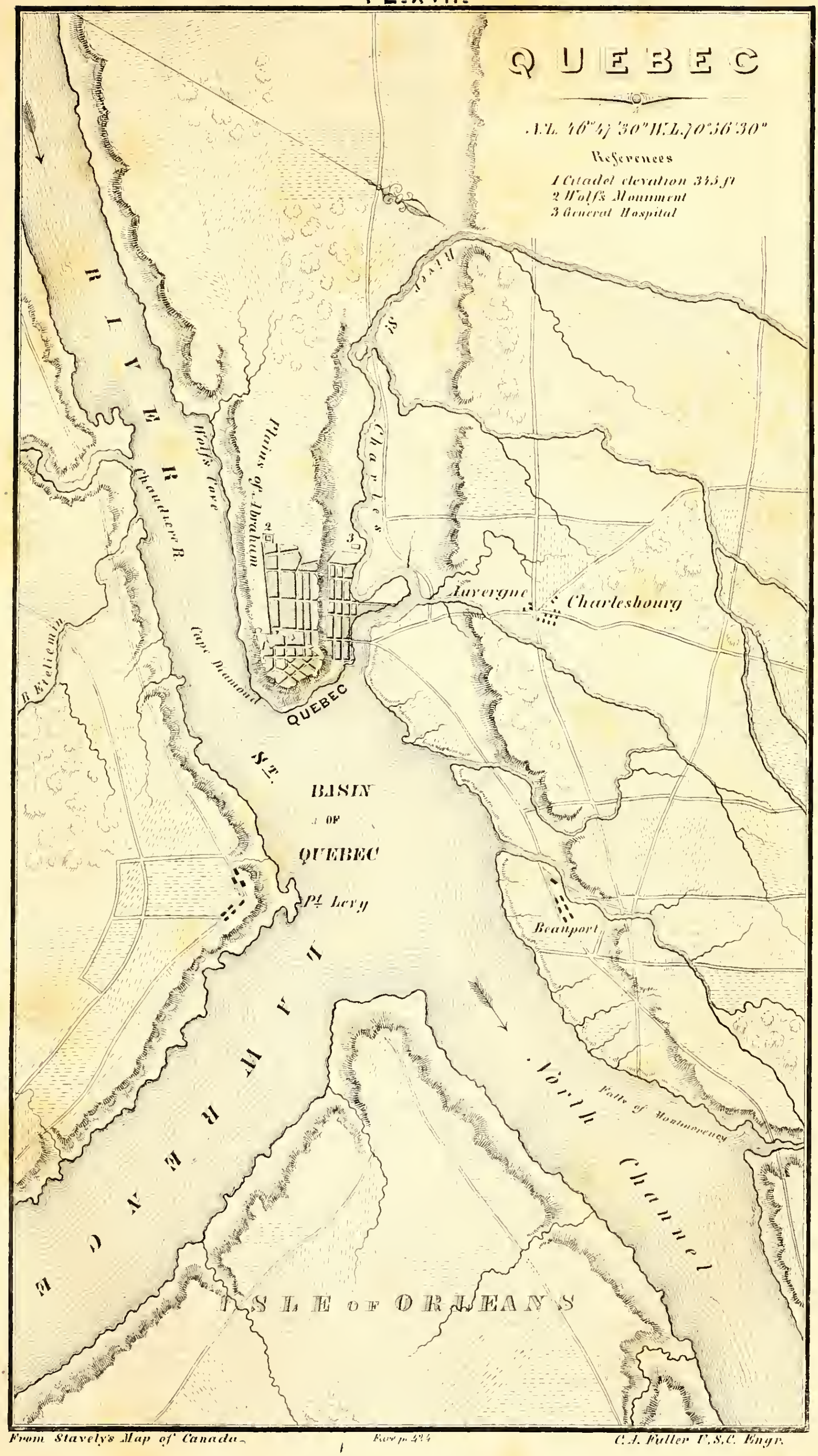
VIII. The River from Montreal to Quebec.— The succession of rapids which begins near Prescott and Ogdensburg, terminates at or a little below Montreal. From that city to the head of tide-water, at the Three Rivers — mouth of the St. Maurice — the fall is only eighteen feet, much of which is in the expiring rapids below the city. Then follows a level, more than one hundred and fifty miles long, with banks rising but little above the surface of the water. This flat extends off from both sides of the river; but, as we have seen, much further on the southern than on the northern. In this stretch of the river we have the expansion — ten miles wide and twenty miles long — called Lake St. Peter. As we approach Quebec, the highlands come in upon the river, which narrows, and no longer exhibits alluvial shores. Such are some of the facts which have suggested the opinion, that the region between the two cities was once a lake, and that the existing Lake St. Peter is all that remains of it. The low banks of this section of the St. Lawrence seem to have been at all times the favorite abode of the French, who still constitute the mass of their population.

SECTION V.

QUEBEC.

I. The approach to this celebrated city (*Pl. XVII*), the oldest in the Interior Valley of North America, is signalized by rocky and rising banks, of which that on the left or northern side becomes almost perpendicular, and, at length, terminates in a bold promontory of old Silurian or transition rocks, rising from three hundred and thirty to three hundred and forty-five feet above the tide-water, which ebbs and flows at its base. This termination it effected by the junction with the St. Lawrence of the River St. Charles; which bears a relation to the northern side of the head-land not unlike that of the greater river to its southern. The high extremity which overlooks the St. Lawrence is called Cape Diamond, and supports the citadel of the fortress,— for Quebec is a fortified city. From these hights, there is a gentle escarpment, up the promontory, to the plains of Abraham, and across it to the estuary of the St. Charles; the final descent into which, however, is by a rocky precipice, to which the ramparts of the fortification conform. The plateau stretches westwardly between the two rivers, to the distance of eight or nine miles, when it is interrupted by a deep and broad depression, one end of which terminates in the trough of the St. Lawrence — the other, in that of the St. Charles. In ancient times there was, no doubt, a flow of water through this depression, from one river to the other, making an island of what is now a promontory.

For four or five miles up the St. Lawrence from Cape Diamond, the river approaches so near the base of the precipice, that there is only room for a single narrow street or road, which, for a portion of the distance, is compactly built along — in some parts on one, in others on both sides. In the rear of these crowded habitations, are the Cliffs, from two to three hundred



From Stavely's Map of Canada.

C. J. Fuller U.S.C. Engr.

feet high, immediately in front of which, the river coves are overspread with rafts of timber, the great commercial staple of Quebec.

As this slip of habitable shore passes round Cape Diamond, it widens; and, at length, admits of another street, to which a third is added, before it reaches the junction of the St. Charles with the St. Lawrence. The squares, however, are very small; and the streets in general barely wide enough to permit carriages to pass each other. This is the LOWER TOWN, which has the aspect and reality of a close and grotesque huddle of business and family houses, which the most searching winds must fail to purify, and the filth from which is cast into the river among the adjoining wharves. On turning the head-land, and entering the valley of the St. Charles, the belt widens into an alluvial bottom, in which there are many small squares, with wider streets, a better style of architecture, and less density of population.

The UPPER TOWN stands on the northern or St. Charles slope of the promontory, partly within and partly without the walls of the fortification. Portions of it have sufficient width of street, and houses in modern taste; but the older parts are amorphous, compact, and strangulated. The St. Charles is an alluvial river, tortuous near the city, and expanding into an estuary; portions of which are daily laid bare by the ebbing of the tide. Beyond it, there are cultivated diluvial terraces. The opposite, or southern bank of the St. Lawrence, presents hills of considerable elevation. Immediately below the junction of the St. Charles, the river expands into a basin, which constitutes the harbor, into the south side of which point Levy projects, and on which there is a town.

For one hundred and sixty years after its settlement by France, Quebec received but few immigrants from any other nation. In 1763 it passed into the hands of Great Britain. The emigration from France was then succeeded by that from England, Scotland, and Ireland, which has continued ever since. A considerable military force has always been quartered in the city, and a large number of seamen are generally in its port. The population of the city and its suburbs amounted in 1844 to 32,876 — that of the county of Quebec, to 45,676, composed of the following classes:

Natives of	England,	1,598
"	Ireland,	7,267
"	Scotland,	981
"	Canada, of French origin,	27,698
"	" of British origin,	7,734
"	Continent of Europe, or otherwise,	276
"	United States,	122
		——45,676 *

This table does not, however, give the proportions in the city, for the relative number of Canadian French in the country is greater than in town.

II. Such is the medical topography of Quebec; and it presents two localities well-fitted to generate autumnal fever; — the coves of the St. Lawrence,

* Cowan's Quebec Guide.

with their macerating logs, and the estuary of the St. Charles. That fever, however, seems to be here unknown, as an original disease. Dr. Parant, one of the oldest and most observing of the French physicians, assured me that he had seen no case not contracted up the St. Lawrence. Dr. Morrin, after an experience of nearly thirty years, affirmed that autumnal fever, as an indigenous disease, was absolutely unknown; and added, that those who came with intermittent fever from the country above, got well spontaneously. The late Dr. Racy, from a shorter course of observation, testified in the same terms Dr. J. Douglas concurred in these statements, and added, that he had repeatedly seen persons attacked with intermittent fever, several months and even a year after they had visited localities in the south-west, where it was prevailing. Finally, the hospital reports, for 1826 and '27, as published in Tessièr's "*Quebec Medical Journal*," confirm the statements of these gentlemen.

In referring to the causes of this exemption, we must not forget that Quebec was settled in 1603 or '–4, and that autumnal fever is, especially, a disease of newly peopled countries. When it disappears, however, it is because the topographical conditions on which it depends are removed. But although much of the country surrounding Quebec has long been cultivated, an entire abatement of those conditions has not taken place; for the coves of the St. Lawrence could never have been in a worse condition than at present: and the estuary of the St. Charles is still in a state to favor the production of that fever. We may conclude, then, that the absence from Quebec of the fever, is, in part, attributable to its latitude, 46° 47′ 30″ north. The same, however, cannot be said of remittent fever, cases of which now and then occur, but invariably tend to a continued type.

SECTION VI.

ESTUARY OF THE ST. LAWRENCE.

I. Taking the head of tide-water as the beginning of the estuary, it starts from the town of Three Rivers, at the mouth of the St. Maurice, eighty-four miles above Quebec. From that point to the island of Anticosti, where the river St. Lawrence opens by two broad mouths into the Gulf of St. Lawrence, the distance is about four hundred and fifty miles. That island lies in the northern part of the Gulf. The latitude of its western end is 49° 52′ 29″ N., its longitude 64° 36′ 54″ W.* Thus its latitude is nearly the same with the sources of the Missouri river, which lie in longitude 112° W., making the breadth of the valley forty-eight degrees of longitude, or about two thousand two hundred miles on a straight line.

It deserves to be noted, as illustrating the natural mechanism of the great intermontane valley, that an air-line from the island of Anticosti over the St.

* Martin's Hist. Brit. Col.

Lawrence, Lake Ontario, and Lake Erie, strikes the Mississippi at the mouth of the Missouri river, without attaining a greater land-elevation than seven or eight hundred feet; and, consequently, it follows, that one hundred miles above Fort Leavenworth, the Missouri river has sufficient elevation to pour its waters into the Gulf of St. Lawrence, instead of the Gulf of Mexico, thirty degrees further south. But we must return to the estuary.

Immediately below Quebec the river divides, and, by re-uniting, forms the beautiful and long-cultivated Island of Orleans; the northern side of which has marshy shores, but they are not aguish. Below this island, the river never contracts to its former limits, but gradually widens to the gulf. At Gros Isle, the quarantine station for the port of Quebec, thirty-two miles below the city, the water has a brackish taste, which, of course, increases as we descend; and unites with the increasing width and depth, in giving to the estuary the character of a bay, or deeply penetrating arm of the sea.

The popular belief that the Appalachian Mountains terminate when they reach the St. Lawrence below Quebec, is erroneous. They are only interrupted, and re-appear on its northern side. Thus the estuary of the river lies in a broad chasm of the mountain chain, the bottom of which, like that of the great lakes, is far below the level of the sea; and, from the interior of the State of Alabama, to the inhospitable regions of Labrador, through twenty degrees of latitude, this is the only gap in the mountain chain, which sinks to the surface of the Atlantic Ocean.

II. On the south side of the estuary, the high lands approach more or less closely to the river, as far down as Cape Gaspé, at the Gulf of St. Lawrence, where they terminate. Opposite Quebec, they reach the river, but not as mountains; further down they recede, and leave a belt of settled and cultivated interval-land, in the county of L'Islet; to which several other belts, generally narrower, succeed; but the proportion of inhabitants, who are chiefly French, gets less and less as we descend. From the close proximity of the mountains, the rivers on this side of the St. Lawrence are all short, none equaling the Chaudiere and other tributaries of the great river, between Quebec and Montreal.

I learn from Dr. Marmette, who has resided nine years in the county of St. Thomas, thirty-three miles below Quebec, and practiced his profession also in the parishes of Berthia and St. Pierre, that the length of coast with which he is familiar, is about eighteen or twenty miles, with a breadth of from one to eight. Near the river, in many places, the surface is flat, but it rises in the manner of an amphitheater, to the high hills or mountains, which are at the distance of a few miles, and at which the settlements terminate. The elevation is from twenty-five to two hundred feet above the level of the tide-water of the St. Lawrence; but there are in the belt a number of hills, either wooded or cultivated. Two small rivers, having numerous tributaries, water the belt, which embraces but few marshes, and they are of limited extent. Several considerable tracts, however, are subject to inundation in the month of April; but the water is always pure, and flows off before the onset of summer, leaving a cultivable surface, some parts of which, converted into meadows, have been ditched. The people of this district are chiefly employed in agriculture, and in getting out timber and stone for exportation. Dr. Marmette has never seen a case of intermittent fever that originated in the district, and does not believe that it is ever produced below Quebec.

Dr. Michaud, who has long resided further down the coast, at St. Louis de Kamouraska, about latitude 47° 31′ north, informs me that within the basin and near the banks of the little river Ouelle, which traverses the belt between the mountains and the estuary of the St. Lawrence, there is a wet savanna or marsh, about five miles long and three broad, which abounds in vegetable matters in a state of decay. The belt presents many diluvial terraces. The population is chiefly agricultural. Of fourteen thousand and sixty-seven cases of disease, treated by him, but three were intermittent fever. Two of these patients had contracted the disease at a previous period in the United States, and the third had sojourned in a paludal situation in the States, ten years before he was seized with the disease in Kamouraska. In the conclusion of his letter, Dr. Michaud makes the following statement, which he believes to be true: "Neither intermittent nor remittent fever has ever originated in the vicinity of marshes situated between the forty-seventh and forty-ninth degrees of latitude, that is, from Quebec to the Gulf of St. Lawrence."

It would seem, from the united testimony of the two gentlemen who have been quoted, that we have here, at the level of the sea, passed beyond the geographical limits of autumnal fever.

III. The valley-land on the other or northern side of the estuary is still narrower, and the cultivation more limited.

The first river below Quebec, is the *Montmorenci*, of no great length or volume, but remarkable for its falls, eight miles below the city. The next and by far the largest which enters the estuary is the

Saguenay.—It joins the St. Lawrence, one hundred and forty miles below Quebec, and at its mouth has been sounded to the depth of two thousand feet, without finding bottom; two miles up, its depth is eight hundred feet, and at the distance of nearly fifty miles, the sounding lead descends to the depth of three hundred feet.

The rocky hills rise with exceeding steepness, on both sides of this river, to the hight of twelve or fifteen hundred feet. At length we reach the place where this river descends into this deep rocky chasm, by a series of rapids from Lake St. John, though its true and more distant sources are the water-shed between the St. Lawrence and Hudson Bay.* Rugged as are the shores of the Saguenay, they are not without inhabitants, who might present to the medical inquirer, opportunities for ascertaining the character of autumnal diseases, in the latitude of 48°, at the level of the sea, though remote from its shores; but I have not been able to acquire the requisite information.

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* Rep. of Com. for exploring the Saguenay, 1829.

Below the Saguenay there are other but lesser rivers, near the mouths of which, and around many small bays of the estuary, there are feeble settlements, concerning which nothing can at present be said, of interest to the etiologist.

IV. The Gulf of St. Lawrence must receive a passing notice to complete our survey of this basin. As but one great river enters the Gulf of Mexico, so but one enters the Gulf of St. Lawrence; and these great rivers have their waters interlocked, from the sources of the Alleghany and Genesee, round to those of the Mississippi, and St. Louis of Lake Superior, a distance of more than one thousand miles. To the south-east, the Gulf of St. Lawrence opens into the Atlantic Ocean, by a broad strait; to the north-east, into Davis Strait, by a narrower, called Belle Isle. Labrador lies to its north, New Brunswick and Nova Scotia to its south-west and south, Breton Island to its south-east, and the great Island of Newfoundland to its east. Around this island, in front of the Gulf, lie the famous sub-marine shoals of Newfoundland, a moment's reference to which, I hope may be pardoned. If the reader will turn to the hydrographical map [*Pl. I*], he will see, that the course of the Lakes and the St. Lawrence, from the sources of the rivers which enter the western end of Lake Erie, is nearly north-east. If he will then carry his eye on the same meridian, to Cape Florida and the Havana, he will perceive the origin of the Gulf Stream, and tracing it by the arrows, will find that its general course is to the banks of Newfoundland, and that the marine and continental rivers flow nearly parallel, yet slightly converged, being separated by the Appalachian mountains, and the plains connected with them. Still further, it has been shown, when treating of the Gulf of Mexico, that a part of the waters of the Mississippi are carried through the straits of Florida, and make a portion of the Gulf Stream. Thus different parts of a shower, falling near the center of the continent, notwithstanding they take nearly opposite directions, at last mingle over the banks of Newfoundland, carrying with them more or less of the surface, either in solution or suspension. Finally, if the reader will glance his eye upon Davis Strait he will perceive by the course of the arrows, that a current, which brings down icebergs from Baffin's Bay, sets, also, upon the banks of Newfoundland, and must transport thither more or less of the *debris* of the arctic regions of the continent. Thus, one terrestrial and two marine currents, meet over those sub-marine beds, and contribute to build them up from the depths of the ocean; while the organic matter, thus transported, attracts such shoals of fishes, as to render this spot the fishery of the world. Such is the magnificent system of hydrology, in which our great Interior Valley plays an important part.

SECTION VII.

PARALLEL BETWEEN THE MISSISSIPPI AND ST. LAWRENCE RIVERS.

I. The Mississippi flows nearly from north to south; the St. Lawrence, originating in the same region, flows to the south-east, and then to the north-east, being turned by the flanks of the Appalachian Mountains. The sources and *embouchure* of the former are in the same meridians — of the latter in the same parallels: One is a river of latitudes, the other of longitudes. It results from these dissimilitudes — *First*, That the banks of the Mississippi will forever present diversities of organic life, both vegetable and animal, far exceeding the varieties offered by those of the St. Lawrence; *Second*, That the diversities of disease along the former will always be more numerous and striking, than along the latter.

II. While the multiplied sources, primary and collateral, of the two rivers are found at nearly the same elevation above the sea, those of the Mississippi reach it by much longer routes than those of the St. Lawrence; and, descending by regularly inclined planes, present, in their course, but few lacustrine pools and cascades. On the other hand, the St. Lawrence is characterized, almost through its whole length, by reservoirs or lakes, rapids and cataracts, exceeding in number, beauty and sublimity, those of any other river of the continent.

III. The quantity of water discharged, annually, by the Mississippi, is much less, in proportion to the area of its basin, than that discharged by the St. Lawrence; which results from the following causes: *First*, But little rain, comparatively, falls on the western portions of the Mississippi basin; *Second*, The deeper deposits of loose, diluvial materials, which bury up its rocky strata, permit more to sink into the earth; *Third*, Greater quantities escape upon the low and broad alluvial plains which border its rivers, than upon those of the St. Lawrence, much of which does not flow back, but is either evaporated or absorbed; *Fourth*, The higher heat of the climate through which the Mississippi flows, for half its entire course, favors greater evaporation than can take place from the St. Lawrence. This evaporation, on the lower Mississippi and the southern tributaries, continues in activity throughout the year, but in the basin of the St. Lawrence, it is almost suspended for one-third of that period.

IV. The amount of drift-wood and softer vegetable matter, borne down to the sea, or lodged along its banks, by the Mississippi, is incomparably greater than that of the St. Lawrence; which results from the looser alluvial bottoms, higher freshets, and more regular descent of that river and its tributaries; and hence it follows, that while the former is thus making deposits in the sea, to be converted into coal, for the benefit of future ages, the latter will be found unfruitful in such benefactions.

V. A still greater difference exists between these rivers, in the quantity of earthy matter which they transport to the sea. Many of the larger tributaries of the Mississippi, and that river itself, for its lower fourteen hundred miles, are always turbid; but the St. Lawrence, on the other hand, is always transparent; and most of its affluents, even when swollen, have less muddiness than those of the Mississippi. This depends on two causes, — one geological, the other mechanical: *First*, The proportion of sandy and argillacious drift or diluvium, overspreading the basin of the Mississippi, is greater than that of the St. Lawrence basin; and it embraces extensive friable deposits, tertiary and cretaceous; *Second*, It abounds in soft shales and marls. On the other hand: *First*, The basin of the St. Lawrence presents a great predominance of hard primitive and transition, or old Silurian rocks, which undergo disintegration very slowly; *Second*, The lakes into which the streams of that basin first pour their muddy waters, become the depositories of their silt, and decant clarified waters into the St. Lawrence. It has resulted from this, that while the Mississippi has filled up the bay, or arm of the gulf, which once projected far into the continent, and is now constructing a cape in the Gulf of Mexico, the St. Lawrence has made but little progress in that labor, and is still met by the tides nearly five hundred miles from its gulf.

VI. In regard to the transportation of ice to the sea, the two rivers differ still more widely. The Mississippi carries none whatever, and is never frozen over, through the lower eight hundred miles of its course: the St. Lawrence, however, freezes every winter, and, below Lake Ontario, is obstructed with ice for one-third of the year. This ice destroys the equability of climate along the St. Lawrence. The breaking up begins in Lake Erie and the Niagara river, then in Lake Ontario, and, progressively, in the river below. By the rapid current in the Niagara and the St. Lawrence, the ice is carried down to the estuary, where it lodges, to a late period in spring, giving to its banks, at and beyond Quebec, a much tardier opening of vegetation, compared with that of the Island of Montreal, than would result from the difference of latitude. On the lower part of the Mississippi, where this disturbing influence does not exist, the increment and decrement of heat are left to the joint influence of latitude and elevation. The annual range of the temperature of the two rivers, in their lower sections, is not the same. In summer and autumn, the Mississippi and its tributaries, greatly reduced in volume, have the heat of their waters very much raised; but the quantity of water in the St. Lawrence varies but little, and is nearly all derived from deep lakes; hence its summer, compared with its winter heat, is much less than that of the Mississippi; thus reversing, as we shall hereafter see, the law of mean atmospheric winter and summer temperature.

VII. In their scenery, the lower portions of these great rivers differ as widely as in other characteristics. On the Mississippi, from Memphis to Baton Rouge, the voyager sees bluffs to his left hand, which gradually get lower and lower, until they disappear; and he finds himself in the midst of a swampy plain, which all along had met his eye, to the right. For two hundred and fifty miles he looks down upon this new creation of the waters, of which the highest ridges are the dykes which confine the river to its proper bed. They at length cease, and before his boat floats on the gulf, he sees the agitation which it raises, drive the turbid waters of the river, over its low and sedgy banks, to mingle with the green tides of the sea. On the St. Lawrence, from Montreal to Quebec, there are also low banks, but higher lands in their rear, and blue mountain masses in the distance; which, as the voyager advances, approach the river, and embrace it more or less closely, to the Gulf of St. Lawrence. The birches, maples, and larches, here represent the cotton-tree, liquid-amber, live oak, and cypress, with its dark silvery tresses of long moss; orchards of plums and apples, are substituted for the peach, fig, and orange tree; and fields of wheat, oats, peas, timothy, and potatoes, take the place of cotton, sugar, and rice plantations.

VIII. By a single aspect, only, is the traveler on the Lower St. Lawrence, reminded of the Lower Mississippi. The depressed banks between Montreal and Quebec, like those through the ancient Delta of the Mississippi, above and below New Orleans, are the favorite abodes of the French. The '*habitant*' and the '*creole,*' under the same national instinct, have placed their cottages in village-ranks, on the banks of their respective rivers, and cultivate long narrow parallelograms in their rear; but the verandahs, climbing roses, camillas, and pomegranates, which decorate these humble dwellings in the south, are wanting on the rigorous shores of the north; and by *their* absence, chiefly, is the voyager preserved from the delusion, that he is not within the Delta of the Mississippi, when his boat is rapidly moving on this portion of the St. Lawrence.

IX. If these two rivers, with their respective geological accompaniments, had been placed respectively, in each other's geographical position, their medical histories would have been widely different from what they now are. The alluvial deposits of the Mississippi would, it is true, have carried autumnal fever, somewhat further north than we now find it; but the greatest difference from the present state of health, would have been found in the south, where a mountain range, and the almost total absence of deposits of silt and organic matter, would have nearly precluded those fevers, which the burning sun of summer and autumn now quicken into annual prevalence.

SECTION VIII.

OF THE ST. LAWRENCE, AS A PLACE OF SUMMER RESORT FOR INVALIDS.

When the invalid, in quest of a cooler and purer summer air, in connection with exercise and recreation, arrives on the southern shores of Lake Erie, he may turn either to the north-west or north-east. In the former case, he will make the voyage upon the Upper Lakes, which has been already described; in the latter, he will visit the Niagara and St. Lawrence, with the lower lakes, Ontario and Champlain.

As the Falls of Niagara fill every imagination, it is unnecessary to speak of their solemn, monotonous, and unequalled sublimity, which does not long sustain the deep emotion which they at first inspire. It will be more profitable to point out to the inquiring and contemplative invalid certain objects, the examination of which cannot fail to interest and excite him. *First,* By a careful inspection of the rocks, he will discover the mode in which they are cut through, and the recession of the Falls has been effected. *Second,* By tracing the gravel banks which are found on both sides of the deep ravine, he will perceive, that a broad surface-stream (such as the river now is above the rapids) once flowed where the chasm has since been excavated. *Third,* He should visit the whirlpool on the Canada side, and trace the channel, now filled with drift and rubbish, by which the river, or a part of it, formerly reached Lake Ontario, near St. David's, several miles west of the present outlet.* *Fourth,* He should then ascend the hights of Queenston, which, though less amazing to his senses, will be found more suggestive to his mind, than the Falls themselves. By his side, the lower end of the dark and winding chasm, with the leaden-green waters, in deep but silent agitation, as they escape from their rocky imprisonment; before him, broad sloping terrace, down which they are quickly gliding to the bosom of Lake Ontario; on every side, the signs that the waves of the lake once dashed against the cliffs, from which he now sees them, at the distance of many miles, and that the Niagara, at some remote period, threw down its torrents from the very summit on which he is meditating. Thus planted, as it were, at the beginning, in both time and place, of two mighty events — the retreat of the Lake and the recession of the Falls — he will soon feel that the pleasures of sense are superficial and fleeting, compared with the deep and bewildering emotions, which arise from a contemplation of the powers by which changes so mighty have been brought forth. But a sojourn of an hour will not raise these discursive and lofty meditations. He should linger for a day, cross the river, look up the black gorge from which it is issuing, ascend the hights of Lewiston, and then descend, and wander among the vast fragments of fallen rock, which in ages long passed, were polished by the dashing waters of the Lake. Thus will his mind be roused into action, and come at length to apprehend the magnitude of the problems which nature here presents for solution.

When the invalid has embarked on Lake Ontario, he should descend by its northern coast, and spend a day, or more, at Hamilton, Toronto, and Kingston; where, in the absence of natural scenery of a striking character, he will find novelties in art and society, which will stimulate his senses and mind, in a different way from the wild grandeur of Niagara; and thus, by a new agency, extend the salutary impression there made.

At Kingston he will reëmbark for the St. Lawrence, and his first stopping-place should be Ogdensburg, on the American side. The voyage will be through the Thousand Islands. The elements of this landscape are a broad plain, overspread with water, sending up through its surface masses and groups of granite, and other primitive rocks, bare and weathered on their

* Hall and Lyell.

low summits, or lightly covered with soil, supporting stunted pines, oaks, and maples. He has now exchanged the sublimities of Niagara for the beauties of the St. Lawrence, and a corresponding change will take place in his emotions. Among the Islands, and below, to Ogdensburg, the current of the river is slow and unruffled. A few miles further down, the first rapids begin, and thence to the Island of Montreal the mingled grandeur and beauty of the voyage raise it above any other of equal length, in the traveled portions of the continent. Everywhere the banks have an aspect of stability, and govern the river, not existing at its mercy like those of the Mississippi. Now they approach, and now they are widely separated by an island; here is a stretch of gentle current, and there a frightful cascade, in which the light-green and limpid waters are dashed into white foam, as they rush furiously down the rocky slope, to repose in some broad basin, with grassy margins, and prepare themselves, as it were, for a new descent. Finally, the blue summits of the mountains which overshadow Lake Champlain, and afterward those of Canada East, begin to peer above the horizon, and by the solemn quietness of their aspect, mingle a new emotion with those which the river had awakened.

A day on the Island of Montreal, is the fashionable allotment; but a week will not exhaust the sources of interest to an inquiring invalid; who can there command every comfort, while he substitutes the novelties of its social condition for those of natural scenery, in a higher latitude than he can reach in the valley of the Mississippi.

The voyage to Quebec will bring only repose of feeling. He is now on tide-water; the rapids are at an end, the river widens, and at length expands into the beautiful Lake St. Peter, then contracts: its course is straight, its banks so low, as barely to rise above the high tides, and so thickly overspread with the cottages of the '*Habitants*,' and the more ambitious dwellings of the *Seigneurs*, that, but for the perfect transparency of the waters they inclose, he might fancy himself on the Lower Mississippi.

A week at Quebec will not exhaust the curiosities of nature and art in which it abounds, nor bring into existence all the historical recollections which it can awaken. Cape Diamond and its citadel — streets with dwellings on one side, and batteries bristling with cannon on the other — embrazures and windows in juxta-position — long ranges of steps from the Lower to the Upper town — gates guarded by sentinels — soldiers, sailors, and citizens, mingled on the same narrow pavement — dogs as well as ponies in harness, and drawing their little wagons through the streets — French and English signs in alternation, on the doors, and the dialects of the two nations, blended within. Thus the foreign invalid, or hypochondriac, may absorb something through every pore, to change the condition of his nervous system. But, escaping from the city, he may drive over the elevated plains of Abraham; then, at the distance of nine miles, visit Lorette, and see a remnant of the oldest civilized Indians of the continent; then, at an equal distance, devote a day to the celebrated Falls of Montmorenci; and, on another, feast his eyes on those of the river Chaudiere, with its wild, romantic scenery.

Quebec is the *ultima thule* of those who make hasty voyages, for idle amusement, or from mere restlessness; but as I am writing for the benefit of invalids, who need the invigorating influence of a cool summer climate, in connection with exercise and new scenes and objects, I shall add, that the voyage, when practicable, should be continued beyond Quebec, to the *Riviere du Loup*, at the distance of one hundred and twenty miles, or even to the Saguenay, thirty miles further down. The great breadth of the estuary, now become a bay, the mountain scenery on both sides, and the coolness of the climate, in a higher latitude than the utmost sources of the Mississippi, would greatly add to the benefits which a southern valetudinary might promise himself from travels in the north.

Returning to Montreal, he should not ascend the St. Lawrence any higher, but cross by rail-road to Lake Champlain, whose grand and picturesque scenery may still interest him, if he have not become cloyed by the natural wonders of the Niagara and St. Lawrence. At the end of this voyage, he may rest at Saratoga, and, then, either descend the Atlantic plain, and visit the cities of the sea-board; or, turning to the west, make his first stopping-place at Syracuse, where the extensive salines will present a new object of interest. From that town he may make a short canal voyage through the beautiful Oswego Valley, which presents several objects of interest, to the town of that name, and there embark for Rochester; or he may continue from Syracuse, by land, and visit the beautiful serpentine lakes of western New York, reaching the city of Rochester by rail-road. Having gratified his curiosity, by the various views which may be had of the Falls by which the Genesee River descends nearly three hundred feet in three miles, he may either proceed to Buffalo, by Niagara, or ascend the Genesee River, and visiting its upper and still grander cascades, traverse the mountain plain to Chautauque Lake, and thence descend to Dunkirk, on the southern shore of Lake Erie.

Conclusion.— The topography of the St. Lawrence or Eastern basin is now closed, but not completed. If, in its progress and at its end, some pages have been devoted to places of hot-weather residence, or routes of summer travel, for the victims of our southern climates, or the invalids of our numerous cities, my brethren, on reflection, will, I trust, approve rather than condemn the object. Nearly all the settled portions of the southern or Mexican basin are comparatively flat and uniform, without lakes or mountains, and deficient in running streams and water-falls. The basin of the St. Lawrence is its *north*, and opens to its invalids, in hot weather, a retreat which they cannot have in any other direction; for the southern portions of the Appalachian Mountains are too inaccessible, and the Rocky Mountains too remote. It is not sufficient for the physician to advise his patient, laboring under a chronic infirmity, to leave off medicine and depend on travel. When he prescribes the former, he directs where it can be obtained; and, in like manner, when he recommends the latter, he should be able to lay down the appropriate and practicable route; in doing which, he should draw his information from the books of his profession, and convince his patient that he is familiar with what he recommends, or but little confidence will be reposed in his advice.

CHAPTER XVI.

THE HUDSON AND ARCTIC HYDROGRAPHICAL BASINS.

INTRODUCTION.

The Mexican and St. Lawrence Hydrographical Basins, include nearly all the white or Caucasian population of the Interior Valley of North America; but its medical topography would be incomplete, and imperfect, even in reference to the diseases of those basins, if some general geographical and hydrographical views were not taken of the more desolate and unpeopled regions which lie to their north, and are quite equal in area to those which have been described. The Hudson Basin, moreover, at one point of its southern border — the sources of Red River — dips into the Mexican as low as the latitude of 45° 30′; thus bringing a part of the northern basins within the limits of prospective settlement and cultivation. The value of a study of the physical geography and meteorology of the northern regions may be concisely presented under the following heads:

I. It is an admitted fact, that if the Rocky Mountains, and other Alpine ranges, which lie to the west of the Mexican and St. Lawrence Basins, did not exist, but the great plain which they now subtend stretched out to the Pacific Ocean, our climates would be entirely different from what they now are; and hence it follows, that he who would understand the latter, must be aware of the existence of the former. If this be true,— and it cannot be denied— it is obvious that the meteorologist should know whether the northern regions are a flat, or overspread with mountain chains.

II. In tracing out the combined and separate influence of soil and climate on our diseases, it is necessary to examine them to the very limits of the continent, in the north, or until they cease from climatic changes.

III. The Northern Basins embrace many tribes of Indians, whose physiology and diseases are to become subjects of study, in the closing part of our work.

IV. In the extreme north there are permanent settlements of Esquimaux, a different race from the Indians, the study of whose constitutions and maladies, under the remarkable circumstances in which they live, cannot be without interest.

V. Both the Hudson and Arctic Basins have been explored by so many Europeans and Americans, that many valuable observations have been made, on the effects of long-continued, intense cold, on the constitutions of the Caucasian races, thus represented in those frigid and dreary regions; all of which stand in curious and striking contrast with the effects of the high and prolonged heat of the tropical regions around the Gulf of Mexico.

A topography of the north is not necessary, however, to the developments here indicated; and I shall limit myself to such comprehensive geographical and hydrographical views, as may be condensed into a single chapter, beginning with the Hudson Basin, which lies immediately north of the two which have been described.*

SECTION I.

THE HUDSON HYDROGRPHICAL BASIN.

I. THE BAY. — A large portion of this basin is overspread with the inland sea, absurdly called Hudson's *Bay*, which lies a little to the north-east of its center. In figure it resembles the transverse vertical section of a mountain. Its base lies nearly in the seventy-ninth meridian, while its apex reaches to the ninety-fifth. The sixtieth parallel of north latitude passes through its center. Its southern extremity, called James' Bay, sinks to the fifty-first degree of latitude, and the opposite rises to the arctic circle. Its area is nearly the same with that of the Gulf of Mexico, from which, however, must be deducted the large Island of Southampton, lying in its northern part, in mean latitude 63°, opposite the entrance of Hudson's Straits, which connect the bay with Davis' Straits and the Atlantic Ocean. The surface of this bay is so obstructed with ice, as to render its navigation impracticable eight months out of every twelve. Even in July and August, Parry and Franklin found the straits which lead to it embarrassed with icebergs; and in its northern regions, great fields of floating ice frequently

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* For the principal facts of this chapter, I am indebted to the following works, to which I shall seldom refer specially in the text, after having cited them here :—HEARNE's Overland Journey to the Polar Sea, 1769—1772. MACKENZIE's Voyage down McKenzie's River to the same sea, 1789. PARRY's First Voyage through Baffin's Bay, 1819—1820. His Second, 1822—1823. His Third, 1822—1825. FRANKLIN's First Overland Journey from Hudson's Bay to the Polar Sea, 1820—1823. His Second from Lake Superior to the same sea, 1822—1823. RICHARDSON's Narrative of his Travels with Franklin, and several of his papers on the geology, zoology, botany, climate and inhabitants of the arctic regions of America. LONG's Second Expedition, to Lake Winnipeg, 1823. Ross's Second Voyage through Baffin's Bay, 1829—1833. BACK's Arctic Land Expedition, 1833—1835.

inclosed the ships of the former, as they had previously done those of other navigators. During winter, this ice is everywhere accumulated on its inhospitable shores, which, even on its southern side, remain frozen to rocky hardness, throughout the longest summers, at the depth of three or four feet below the surface. In some parts the coasts are bold and rocky; in others, low and swampy, like those of the Gulf of Mexico; — and this, according to Doctor Richardson, is especially true of those which lie farthest south.

Although Hudson's Bay was discovered by the intrepid but unfortunate English navigator whose name it bears, as early as 1610, its desolate shores have but few civilized inhabitants, except the officers, voyageurs, and trappers of the United Hudson's Bay and North West Fur Companies. They reside or congregate at a few factories, chiefly near the mouths of rivers, on the southern coast, from the mouth of Nelson's River to the head of James' Bay, where there are some limited settlements of a more permanent kind. This failure in the colonization of the shores of a sea, which correspond in latitude with those of the Baltic, where we find the large cities of Stockholm, Copenhagen, and St. Petersburg, will cease to excite surprise, when we reflect on the physical condition which has been described; and as this condition is permanent, the colonization of these coasts must forever remain extremely limited.

II. General Hydrography of the Basin.— A single glance at the map (*Pl. I*), will disclose the hydrology of this basin. Small lakes abound everywhere, except in the south-west. To the east, in the direction of Davis' Straits, and to the south-east and south, toward the St. Lawrence and its parent lakes, the country is, in fact, essentially lacustrine. From the north-west side of Lake Superior, a chain of small lakes, connected by Winnipeg River, extends north-westwardly to Lake Winnipeg, the largest lake within the basin. Beyond it, in the same direction, the lacustrine zone continues, until the basin is traversed from south-east to north-west. South-west of this chain the number lessens; but to its north-east they abound, quite to the shores of the great bay. All these lakes are either the sources, expansions, or receptacles of rivers, which finally mingle their fresh waters with the briny tides of the bay. Of these rivers, beginning in the east, the principal are, East Main, Rupert, Abbitibbe, and Albany; which, originating in the water-shed that separates the St. Lawrence and the Great Lakes of that basin from the Hudson, discharge themselves into James' Bay. Then follow, in advancing westwardly, the Severn, Hayes', Nelson, and Churchill Rivers, which pour their more copious torrents, including the overflows of Lake Winnipeg, into the southern side of the bay. Further north, is an extensive group of small lakes, having their outlet through a short river, into the head of Chesterfield inlet, a long, narrow arm of the bay, lying nearly in latitude 63°. Of the region in the north, between the bay and the polar seas, but little is accurately known, except that they abound in ice, and are frightfully desolate. From this rapid hydrographical survey, we perceive, that the Hudson Basin, with the exception of its extreme south-west, presents a vast extent of watery surface, which for more than half the year is bridged over with ice, sometimes ten or twelve feet thick.

III. Physical Geography of the Basin, north-east of the chain of Lakes which includes Lake Winnipeg.— This, which is the larger portion of the basin, includes the bay. Its rocks are chiefly, if not entirely, primitive. The covering of soil is thin and infertile. The annual vegetation is scanty, but advances rapidly during the short summers. The patches of thin forest are composed largely of terebinthinate trees, with oaks, maples, poplars, birches, and willows, generally of stunted size. It probably has no mountains which rise to the altitude of two thousand feet, except they should lie on its eastern margin near the Labrador coast. Its northwest and north includes a part of the "Barren Ground," of which something will be said in the next section. The variety of its resident quadrupeds is not great; the bison is not found within six hundred miles of the bay, and perhaps does not inhabit this portion of the basin; moose and reindeer abound; grallic and graminivorous birds migrate in winter; in summer, the birds of the south, especially the water-fowl, arrive in great numbers, to hatch and rear their young.*

The northern shores of Hudson's Bay are thinly inhabited by Esquimaux. Scattering hordes of Indians inhabit the regions south and south-east of the bay. The fur companies have establishments at the mouth of Churchill River, Hayes' River, Albany River, Moose River, and Rupert's River, also at the outlet of Lake Winnipeg, and a few other places; but there is no European colony. It need scarcely be stated that autumnal fever does not occur anywhere in this half of the basin we are now exploring.

IV. Regions south and west of Lake Winnipeg.— It is agreeable to turn from a region so desolate, to one which displays a very different character. Its limits, to the north, are the water-shed which divides the Saskatchawan, of Lake Winnipeg, from the Athabasca, of the Arctic basin; to the west, the Rocky Mountains; to the south, the sources of the Missouri, Mississippi, and St. Lawrence. Its area is equal to five or six of the larger states of the Valley of the Mississippi. Its chief rivers are the Saskatchawan, which flows from the slopes of the Rocky Mountains, eastwardly to Lake Winnipeg; Red River, which flows to the north, from the water-shed which separates it from the Mississippi; and the Assiniboin, which drains the country between them, and joins Red River, just before the latter pours its waters into the lake. The region we are now in, has everywhere a sub-stratum of secondary rocks, and its surface is smoothed down into plains, which are, in fact, a continuation, to the north, of those traversed by the Missouri River. The trees are chiefly found along the streams; the short grass supports buffalo and other quadrupeds; the streams are frequented by the fur-animals; and the tribes of Indians are more populous than in the other portions of the Hudson Basin. After these general notices, it will be proper to give a minuter account of some portions.

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* Richardson.

V. Valley of Red River.— The best topographical account of this valley, is that given by Colonel Long,* who describes the river as originating in part, on the same plateau with the Mississippi, in part on the high plain north of the *Coteau des Prairies*, and, partly, in the intervening depression, where it interlocks with the St. Peter's. Its length is about five hundred miles, but the plain over which it flows is so little inclined to the north, that its current is gentle, and its bed exceedingly tortuous. It has no falls, and its junction with Lake Winnipeg is by a broad, marshy estuary, overspread with aquatic grasses. Throughout its whole course, the banks are low, and unsupported in the rear by hills; its bed is, in fact, a mere trench, dug through the prairies. The margins are overshadowed with forest trees, which increase in size and number as we descend the river.

Colonel Long's party encamped, by night, on the prairies near the river; in reference to which Professor Keating, the historiographer of the expedition, observes: —

"These nights made a more lively impression on several of the party, than any of those that had preceded them. The beautiful and boundless expanse of the prairies, as seen by the bright moonlight which we enjoyed during that period, the freshness of the night air, the stillness of the scenery, interrupted only by the howlings of the wolf and the lowing of the buffalo, the recollections of the dangers from Indians which had lately threatened us, and against the recurrence of which we were then watching; all these were likely to suggest to the mind melancholy yet not unpleasant reflections."

Among the tributaries of Red River, the most important is the Assiniboin, which makes its way from the west. In length and volume, it is equal to the river, with which, about in latitude 50°, its waters mingle. The topographical character of the basin of this tributary, is probably analogous to that of Red River.

Settlements.— About the year 1812, Lord Selkirk attempted to plant a European colony, consisting of English, Scotch, and Swiss, on the banks of Red River. Two settlements were effected, of which the upper or southern was near latitude 49°, at the mouth of the small river Pembina, which gave its name to the village; the lower, at the mouth of the Assiniboin, a degree further north. It was called after that river, and constitutes one of the most northern settlements (fur-trading houses excepted) in the Great Interior Valley. In the year 1833, the population of the colony amounted to three thousand and seventy, and may now amount to five thousand.† This, I believe, is the only *Colony* within the Hudson Basin, and the most northern permanent agricultural settlement in the Interior Valley. Colonel Long, who visited this colony, in the month of August, 1823, found the people in health, and says nothing in his journal of autumnal fever. I am, however, informed by him, that not a single case of that disease was seen in the colony; and Doctor Rowand, after residing

* Second Expedition, Volume II.

† History of the British Colonies, by R. M. Martin, Vol. III, p. 534.

there more recently, has assured me, that both intermittents and remittents are unknown; yet the topographical conditions are favorable to their production. If we may rely on these observations, the latitude of 49° N. is beyond the limits of those forms of fever. But doubtless, they cease short of that parallel, though, from the absence of settlements, the latitude cannot be assigned. On the St. Lawrence, we have found them occurring near the forty-seventh degree, but at the level of tide-water; in this basin, at an elevation of seven or eight hundred feet, they may be expected to cease further south. Colonel Long says that his party could hear of none beyond the forty-fifth degree; but I have already mentioned (on doubtful authority) their occurrence at Sandy Lake, in the latitude of 46° 48′.*

VI. Valley of the Saskatchawan. — According to Doctor Richardson,† secondary limestone is the sub-stratum of this great valley, and probably of the whole region from Red River and Lake Winnipeg, to the base of the Rocky Mountains. Argillaceous deposits are common along the lower part of the river; but, further west, the surface becomes sandy or gravelly, and the limestone formations are buried up. The former region presents forest trees on the banks of the river; but the latter is destitute of that embellishment, and produces only short grass. On the north fork of the Saskatchawan there are beds of coal. No colony has yet been planted on the banks of that river; but the fur-trading establishments are numerous. It does not appear that any of them are infested with autumnal fever; but goitre and cretinism are endemic in some localities,— of which more will be said hereafter.

Much of the great region west of Lake Winnipeg and Red river, seems fitted for settlement, but its remoteness, and the motive of keeping it as a hunting and trapping ground, will, perhaps, long prevent its colonization. Its aboriginal and fur-trading populations are more numerous than those of any other portion of this basin, in which respect it is not without interest to the medical historian.

VII. Locality of the pole of Magnetic Intensity.— The intensity of terrestrial magnetism is measured by the number and strength of the oscillations of the needle in a given time. Observations have disclosed that, in each hemisphere, there are two poles or *foci* of magnetic intensity, neither of which is coincident with a pole of dip and direction. One is within the basin we are now exploring, in lat. 52° 19′ N. and lon. 91° 59′ W. (*See Pl. I*). The isodynamic lines, or lines of equal intensity, are "closed and irregular curves" which have their common center at the spot which has been indicated.‡ It is worthy of remark, that Professor Forbes, of Edinburg, has shown that the magnetic force diminishes as we ascend from the level of the sea.

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* Ante, p. 331.

† Franklin's First Journey to the Polar Sea, p. 452.

‡ Major Sabine: Transactions of the Royal Society for 1846— Proceedings of the British Association. Ibid.

This comprehensive outline of the widely extended HUDSON BASIN, is all that our plan requires. We must now leave it for the fourth and last basin, of which a notice equally concise will be sufficient.

SECTION II.

THE ARCTIC HYDROGRAPHICAL BASIN.

I. LIMITS.— This basin includes the remainder of the Interior Valley of North America (*Pl. I*). In the north, it is everywhere terminated by the Polar Sea, which bounds it from the eighty-first to the one hundred and thirty-sixth or thirty-seventh meridian. The range of coast has the mean latitude of 70° N. The eastern part of the basin, which lies between Hudson's Bay and the Polar Sea, is comparatively narrow. The longitude of this portion is between 81° and 95°. After traveling westwardly from the Bay, through ten degrees of longitude, we find the Arctic basin dipping down to the south, and, following the line of separation between it and the Hudson Basin, to the Rocky Mountains, we see it as low as the fifty-fourth parallel; from that point, pursuing its western boundary — the Rocky Mountains — to the Polar Sea, we pass through sixteen degrees of latitude.

II. LAKES.— This basin, like the Hudson basin, is traversed nearly from south-east to north-west by a chain of lakes, which is a continuation of that referred to in the last section (*See Pl. I*). The principal elements of this lacustrine axis, counting from the south, are Lake Athabasca, Great Slave Lake, and Great Bear Lake, with numerous appendages and straits. A line drawn through them and prolonged to the south-east, would cut Lake Winnipeg, Lake Superior, Lake Huron, and Lake Erie. The mean latitudes and longitudes of these lakes are nearly as follows: —

Athabasca Lake,	N. lat.	59°	W. lon.	109°.
Great Slave "	"	61° 30′	"	113° 30′.
Great Bear "	"	66°	"	120°.

Between, and to the north-east of, these large lakes, in the direction of Hudson's Bay and the Polar Sea, there is a countless number of small lakes and ponds, some of which are connected with the larger, others insulated. To the south-west they are less numerous.

III. RIVERS.— A chain of small lakes stretches northwardly, from the eastern end of Great Slave Lake, and gives origin to the *Thlew-ee-choh*, *Great Fish*, or *Back's River*; discovered and first descended by the enterprising traveler whose name it bears. This river, the most eastern, as yet known of the Polar Basin, flows by a rapid descent, nearly north-east, to the sea, in Lat. 67° 11′ N., and Lon. 94° 30′ W.

Copper Mine River, first descended by Hearne, in 1771, and afterward by Franklin, in 1820, has its origin and termination near the northern shore of Great Slave Lake. Beginning, like the last, in a chain of small lakes, it descends to the Arctic Ocean, in Lat. 67° 48′ N., and Lon. 115° 37′ W. Its banks are more or less wooded. On the opposite or south-west side of the

Athabasca, Slave, and Bear Lakes, the number of ponds and small lakes, as already stated, is much less; but the rivers are of greater length and volume, being supplied by the Rocky Mountains. Although receiving different names, they finally unite into one trunk, first descended by Mackenzie, in 1789, and subsequently by Franklin, in 1823. It has received the name of its first navigator, and deserves a more extended notice than the preceding.

Mackenzie's River is of Rocky Mountain origin. Under the name of Athabasca, it commences in those mountains, about in latitude 52° and longitude 116°, and flowing to the north-east, pours its waters into the lake which bears its name. A few degrees further north and west, the same mountains send down another, the *Unjigah*, or *Peace River;* which, flowing nearly in the same direction, passes close to the western extremity of Athabasca Lake, with which it is connected by straits or bayous, through which, when swollen, a part of its waters enter that lake, to be returned when it subsides. Having established this connection, it turns to the north, and taking the name of Slave River, pours its accumulated waters into the south side of the Great Slave Lake. Still further north than the sources of the Athabasca, the Rocky Mountains throw down another river, the *Turnagain*, or *Liards*, which first flows to the east, and then to the north, to join the outlet of Great Slave Lake, and form the Mackenzie, which, pressing hard upon the base of the Rocky Mountains, seeks the ocean by a north-west course. On its way, the volume of its water is augmented by the effluent or outlet of Great Bear Lake. Its junction with the Arctic Sea, marked by a broad estuary, abounding in islands, is in mean Lat. 69° N., and Lon. 136° W. Thus it drains the north-west corner of the Great Interior Valley, and takes the same rank among the rivers of the Arctic Basin, with Nelson's River in the Hudson, the St. Lawrence in the basin of that name, and the Mississippi, in the Mexican basin.

IV. Physical Geography of the region west of the Lacustrine Axis. — The region lying between Athabasca, Slave, and Bear Lakes, on the one hand, and the Rocky Mountains on the other, traversed, as we have just seen, by the rivers which compose the main trunk of the Mackenzie, is, properly, a continuation of the great inclined plain, which descends eastwardly from the base of the Rocky Mountains, and has been already described as making a part of the Hudson and Mexican Basins; but in these high latitudes it becomes much narrower. Extending, with some modifications, from the mouth of the Rio Grande, of the Gulf of Mexico, to the *embouchure* of the Mackenzie, in the Arctic Sea, it ranges through forty-four degrees of latitude, and is doubtless the longest tract of the kind, which the earth anywhere presents. From south to north, it has certain characters in common: *First,* It is most elevated near the Rocky Mountains, which everywhere bound it to the west. *Second,* The secondary formations which constitute its surface, are more or less buried up with the *debris* of the rocks and that of the mountains. *Third,* It is deficient in springs, because the rains which fall upon it are imbibed by this *debris,* and not afterward collected into subterranean streams. *Fourth,* Its scanty forests are chiefly found on the humid banks of the rivers. *Fifth*, The intervening plains (prairies) are covered with grass. *Sixth*, It is the great pasture-field of the bison, which, except in the valley of the Ohio, has not been found in numbers, east of its limits; but ranges north upon it, up to the fifty-second degree of latitude.* *Seventh*, It is inhabited throughout by Indians, who wander over it, like the wild herds on which they subsist. *Eighth*, Like that part of the Hudson Basin which lies to the south, it is a fur-country, and the Hudson's Bay, and North West Companies, have factories in various parts of both.

If autumnal fever does not exist in the prairies of the Hudson Basin, at the latitude of 49° N., we should not expect to read of its occurrence in the same latitude in the region west of the lacustrine axis, and we have no accounts of its existence there.

V. Physical Geography of the region east of the Lacustrine Axis. — The topography of this portion of the Arctic Basin, presents a striking contrast with that just described. While the latter enjoys a sub-stratum of secondary rocks — argillaceous, calcareous, and carboniferous — the disintegration of which, with the *debris* of the mountains, brought down by many large rivers, gives a soil capable of supporting a tree and herbaceous vegetation, up to the latitude of 68° or 69°, thus rendering it habitable; the former is composed almost entirely of primitive rocks, of which gneiss is the principal, with extreme deficiency of soil, and excess of water, because the strata below are impervious, while the prevailing flatness of surface leads to its accumulation into swamps, pools, and small lakes, which the severity of its winters converts largely into ice, that is not entirely melted in summer. For a certain distance, east and north-east of Great Slave and Athabasca Lakes, the sterility is less, and open forests of dwarf pine, poplar, birch, and willow, are not entirely wanting; but beyond a line, drawn from the middle of Great Bear Lake, in latitude 65°, to Hudson's Bay, in latitude 60°, the Arctic, like the adjacent portion of the Hudson Basin, is utterly uninhabitable by civilized races. The region to the north-east of that line constitutes, in fact, the "*Barren Ground*" of the Indians and the British traders and travelers. Of the last, it has been traversed by Hearne, Franklin, Richardson, and Back; while Ross was imprisoned for three years on its icy coast, in the Gulf of Boothia, not far from the mouth of Thlew-ee-choh, or Back's River. All the accounts of these hardy and courageous travelers, concur in representing this great region, with the exception of the banks of Copper Mine River, which are the best, as one of the most repulsive and uninhabitable on the globe; and yet it is more or less traveled over by Indians in summer; and its northern borders are the permanent residence of tribes of Esquimaux, whose subsistence, however, is drawn chiefly from the sea, through apertures made in the ice.

VI. The Arctic Ocean. — No portion of the universal ocean is less known, than that which throws its eternal ices on the northern coasts of the

* Richardson.

Interior Valley of our continent. For more than two hundred and seventy years, all the attempts to cross it, to the west, from Baffin's Bay, have ended in disappointments, equaled only by the intense sufferings of those who have regarded the glory of discovering a "North-west Passage" from the Atlantic to the Pacific Ocean, as paramount to all exposures, hardships, and perils. Not even a coasting voyage, in the latitude of seventy degrees, from the peninsula called Boothia Felix, to Behring's Straits, has yet been performed. In a latitude four degrees further north, Melville Island, in longitude 110°, is the furthest land which has been explored in the western voyage. Whether the Arctic Sea extends to the north pole is quite unknown; but since the continents of both the old and the new world terminate near the same latitude, the presumption is in favor of the existence of a true polar sea. The route from Baffin's Bay to Melville Island, is through Lancaster Sound and Barrow's Straits. On the south lies Cockburn Island, unexplored — on the north the land is probably insular. From the straits, Prince Regent's Inlet dips down to the south, with the island just named on its east, and the peninsula of Boothia Felix on its west. The termination of this inlet is in an expansion called the Gulf of Boothia. These lands are buried up in snow and ice through most of the year, and are destitute of trees. Much of them rises but a few hundred feet above the level of the sea, and not a single elevation deserving the name of mountain has been met with. To the west of them lies an impenetrable icy ocean.

VII. Locality of the Pole of Cold. — Thermometrical observations in the polar regions, have enabled the mathematical meteorologist to determine, that there is not *one* pole of cold for the northern hemisphere, and that, coincident with the terrestrial pole, as might have been expected — but *two*, of which one is in the continent of Asia, the other of America, nearly 180 degrees apart. These regions of lowest terrestrial temperature, are nearly in the same latitude. That of America (*Pl. I*) covers the sound, strait, inlet, peninsula, and island mentioned under the preceding head, which lie in the mean longitude of 90° W., and the mean latitude of 75° N.* Thus, the Valley of the Mississippi, the Upper Lakes, and Hudson's Bay, are directly south of the pole of cold for this continent.

We have seen in the preceding section, that the pole of magnetic intensity is found between Lake Superior and Hudson's Bay, in the ninety-second meridian, and consequently it coincides, in longitude, with the pole of cold.

VIII. Locality of the Magnetic Pole of Direction and Dip. — Modern researches in terrestrial magnetism have demonstrated that, instead of two poles of magnetic dip and direction, corresponding to the poles of the earth, there are two in each hemisphere, all of which are found at some distance from the terrestrial poles. In the northern hemisphere, one exists on the continent of Asia, the other on that of America. By calculation from numerous data, their places were assigned, *a priori*, with such precision, that an observer was enabled to reach that of this continent, and, by experi-

* Kaemptz's Course of Meteorology, London Ed., by C. V. Walker.

ment, confirm the results of mathematical deduction. In the summer of one of the tedious years, during which the British ship Victory, commanded by Captain, now Sir John Ross, R. N., was lying, ice-bound, in Victory Harbor, on the western side of the Gulf of Boothia, Commander, since Captain James C. Ross, aware of their proximity to the spot which had excited so much curiosity in the scientific world, made a journey of thirty miles, along the south-western coast of the peninsula called Boothia Felix, and, on the first of June, 1831, found himself on the MAGNETIC POLE. The needle no longer had any horizontal motion, and its dip was 89° 59′ 86″, within less than a quarter of a minute of being vertical. The latitude of the place where this observation was made, proved to be 70° 5′ 17″ N., its longitude 96° 45′ 48″ W. A cairn of sea-side pebbles was erected, and the British flag left waving over it.*

It will be observed that the magnetic pole of dip and direction is 17° 46′ N., and 4° 46′ W. of the pole of magnetic intensity; and that it falls within the (imperfectly defined) limits of the pole of cold. In reference to more southern parts of the Interior Valley of the continent, the astronomical meridian of 96° 45′ 48″, passes nearly over the center of the great plains between the Mississippi River and the Rocky Mountains.

TOPOGRAPHY CONCLUDED.

With these notices of the Arctic Basin, our geographical, topographical, and hydrographical survey of the Interior Valley of North America is brought to a close; except when the study of particular forms of disease may recall us to the work of description. Of the four hydrographical basins, the two southern are not equal in area to the two northern; yet they must forever contain nearly all the civilized inhabitants of the Valley. From the Gulf of Mexico to the Polar Sea, the distance is equal to forty degrees of latitude; and if this be divided by the fiftieth parallel, that portion of the valley which lies beyond it, will remain nearly destitute of inhabitants, while much the larger part of the other will admit of settlement, though in very unequal degrees. The inhospitable character of the northern basins does not result, however, from the nature of their surface alone, but from that and their climate combined, of which we shall see conclusive proofs in the investigations on which we are now prepared to enter. If the different basins were separated from each other by parallels of latitude, the climate of each might, like its topography, be studied by itself; but many portions of the two eastern lie in the same latitudes with the two western, and consequently possess the same climates; it will be necessary, therefore, to study the meteorology of the whole in connection, beginning in the south and proceeding to the north.

* Ross's Second Voyage, Am. Ed. p. 331, Trans. Roy. Soc., 1836, Part I, p. 52.

PART SECOND.

CLIMATIC ETIOLOGY.

CHAPTER I.

NATURE, DYNAMICS, AND ELEMENTS OF CLIMATE.

SECTION I.

GENERAL VIEWS.

I. Climate occasions Diseases.— As no fact in etiology is more universally admitted, than the influence of climate in the production of disease, it follows that he who would understand the origin and modifications of the diseases of a country, must study its meteorology. The effects of climate are both predisposing and exciting. Thus, the long-continued action of a particular kind or condition of climate, may bring about such changes in our physiology as to incline us to some particular form of disease; while sudden changes often act as exciting causes to other diseases, to which we may be inclined, from agencies not connected with climate. Again, the influences of climate are both direct and indirect. The former result from the immediate action of the atmosphere on our systems — the latter from its action on the matters which are accumulated on the surface of the earth, which are thus made to send forth agents of an insalubrious character. Thus, the same state of the earth's surface which in one climate may prove highly pernicious, in another may be altogether harmless.

II. Climate cures Diseases.— But climate must not be studied with a reference to etiology only; for it can cure as well as occasion disease. It modifies the effects of blood-letting, medicines, and regimen; and although it maintains some diseases against the united powers of the most active and appropriate articles of the materia medica, it cures others in the absence of the whole. Considered as a therapeutic agent, it is, when skillfully ordered, entitled to great confidence. Its action is not often speedy, but the certainty of its salutary effects, in general, compensates for their slow development.

III. Definitions of Climate.— In physical geography, the word climate expresses a zone of the earth, running parallel to the equator, of such width that the longest day at its northern limit is half an hour longer than that of its southern limit, supposing we are in the northern hemisphere; but in etiology and therapeutics, the term is used in a different sense, and simply expresses states of the atmosphere. These states involve, or consist in, varying quantities or qualities of certain elements of the air itself — its caloric, light, and electricity; its aqueous vapor, fogs, mists, and clouds; its dews, rain, hail, frost, and snow; its weight and density; its movements or winds; its factitious gases, and mechanical impurities; all of which may be very different in different times or places of the same geographical climate, and nearly the same in different zones.

IV. Climate of a Globe of uniform surface.— If the earth, with its present form and relations to the sun, had a smooth, uniform, terrestrial surface, of the same mineral composition, and were destitute of both air and water, the temperature of its crust in every latitude would bear a fixed relation to the solar influence. If, then, an atmosphere were added, winds would be created, and blow with a uniform velocity and direction, as the same seasons returned. But if mountains were anywhere upheaved, or the atmosphere should be impregnated with aqueous vapor and electricity, this uniformity would be disturbed; which prepares us for considering the proper elements of climate.

V. Elements of Climate on the Globe as it exists.— The crust of the earth is not uniform in chemical composition or surface; it abounds in mountains, plains, and valleys, distributed in a very irregular manner; portions of it are densely overshadowed, while others are destitute of forest; the larger part is covered with oceans, lakes, rivers, and swamps; an elastic atmosphere rests upon the whole; and every part — solid, fluid, and aeriform, — is permeated by electricity. Were the earth, with this surface, removed from the influence of the sun, the phenomena of climate would be annihilated; in that luminary, then, reside the dynamics on which they depend; and the rays of light and heat, are the efficient agents by which its quickening influence is exerted on the earth. When they reach its surface, their effects are, substantially, according to the angle of incidence; but falling on material elements so diversified, a vast variety of movements are generated, and results or phenomena the most complicated, are incessantly developed. Thus, unequal degrees of heat are accumulated in portions of a continent having the same latitude, but different elevations; or, as they are covered with forests or destitute of shade; the heating and cooling of the land and water do not proceed according to the same laws; aqueous vapor is raised into the air from the oceans and transported over the continents, by winds, generated by the unequal heating of the atmosphere, to be condensed and precipitated, on regions remote from those in which the evaporation took place; in the condensation of the vapor, caloric is liberated,— by the evaporation of the fallen water it is absorbed; the clouds intercept the rays of the sun and limit their effects upon the surface, but, at the same time, arrest and throw back much of the caloric which radiates from the surface; dead calms and hurricanes rapidly succeed each other; electrical phenomena are generated; the luminous solar rays are decomposed by the clouds, which they tinge with various colors; finally, different gaseous exhalations, from decomposable matters lodged on the surface of the earth, ascend into the atmosphere.

VI. THE ELEMENTS OF CLIMATE NOT THE SAME IN DIFFERENT PARTS OF THE EARTH.—It results from what has been said, that the elements of climate are not precisely the same in any two regions of the globe; and. therefore, that the climate of every region, even in the same latitude, must possess some peculiarities; the causes of which are to be sought in the physical geography and hydrography of the region itself, and of those by which it is immediately surrounded. For this aid to the study of the Climate of the Interior Valley of North America, the necessary facts have been given in Part I; but as they are scattered through several hundred pages. it will be useful to collect and condense them into one section.

SECTION II.

CAUSES WHICH MODIFY THE CLIMATE OF THE INTERIOR VALLEY.

I. As the axis of the Valley lies nearly in the meridian, and reaches from the torrid to the frigid zone, it presents in its climate all the modifications which can result from the different effects of the sun's rays, in the different latitudes.

II. The elevation of its surface above the level of the sea, in a broad zone, running nearly through its center from south to north, is remarkably uniform; yet the southern half of the Valley inclines a little toward that luminary, and the northern declines at an equal angle from it. As the former augments, and the latter diminishes, the califacient power of the solar rays, the climatologist ought, perhaps, to regard the sum of the two, as an element of the peculiarities of our climate, but its value cannot be estimated.

III. The proportion of watery surface varies widely in different parts of the Valley. In the Southern Basin, the neighborhood of the Gulf, and the delta and trough of the Mississippi, present nearly all the surface that is, either constantly or occasionally, covered with water. To the east of that river, the whole country is without lakes or extensive morasses, and the rains, from the ridgy character of the surface, are collected into running streams. To the west, the vast regions, quite up to the Rocky Mountains, constitute an inclined plane, with but few rivers, and scarcely a single lake or swamp, of sufficient area to deserve consideration. The soil is bibulous, and the rains are absorbed. Thus the greatest part of the surface of this region is not fitted to afford a large quantity of vapor. The Eastern Basin is essentially lacustrine; having, in addition to the great lakes from

Ontario to Superior, a countless number of smaller ones, often bordered by extensive swamps; it must, therefore, supply a vast amount of vapor. The Northern Basins, with the exception of the plains which lie in their western portion, abound in watery surfaces, to an extent still greater than the Eastern; and although lying far in the north, most of that region must necessarily exhale an immense quantity of vapor during the warm season. If the waters of the Eastern and Northern Basins were transferred to the Southern, it cannot be doubted that a remarkable change of climate would be the consequence in both.

IV. In the Southern Basin, a zone around the Gulf of Mexico is covered with trees; and all the regions east of the Mississippi, up to, and including, most of the Ohio Basin, quite up to the summits of the Appalachian Mountains, were originally overspread with compact and lofty forests. From the Ohio Basin, west, to the Mississippi River, the prairies divide the surface with the wood-lands, and in many parts of Illinois and Southern Wisconsin they predominate. West of the Mississippi, the zone of wood-land country, below the mouth of the Missouri, is from one to three hundred miles broad; but the prairies press much more closely on the upper section of the river. In all parts of the prairie region, even to the Rocky Mountains, the trees are almost confined to the banks of the rivers. The broad intervening plains are sandy; but fertile enough to be clothed with short grass. There are no herbless deserts. The Eastern Basin is generally wooded. In the two Northern Basins, the extent of forest is greatly diminished; the larger part of what exists, except in its southern portion, is composed of small trees with a limited amount of foliage. To the north-west and north of Hudson Bay, the "Barren Ground," of vast extent, is almost destitute of trees. The western portions of these hyperborean Basins, are as deficient in forest, as the western half of the Southern Basin. Thus the wood-lands of the great Valley, are chiefly found toward its eastern side, from the Gulf of Mexico to Hudson Bay. These forests retard the heating of the earth's surface in summer, by intercepting the rays of the sun; and at night they diminish the radiation of heat from the same surface; and the radiation takes place from the canopy of leaves. In both summer and winter, they diminish the velocity of the winds. On the treeless plains, the power of the sun is greater, the nocturnal radiation from the ground greater, and at all times the velocity of the winds (the forces which generate them being the same) is more rapid. A necessary effect of settlement and cultivation, is the destruction of the forest; and thus every year, the wooded is making an approach in area to the woodless part of the Valley.

V. The forest lands have a much denser population than the prairies; and all the modifying influences of heated air, smoke, gases, and aqueous vapor, liberated and sent abroad in the atmosphere, exist in a much higher degree to the east than to the west of the Mississippi River.

VI. The mountains which bound the Valley on either side, deserve great consideration. To the east, or rather south-east, the Appalachians stretch, in many parallel or coalescing ridges, from Alabama to the region north of the Gulf of St. Lawrence, rising from two to five thousand feet above the sea. They no doubt contribute to some extent, to give direction to certain winds. When an easterly wind prevails, they deprive it, by condensation, of a portion of the moisture with which the warm Atlantic Ocean had imbued it, and reduce its temperature; and hence, on the banks of the Ohio, and in other central portions of the Valley, a south-east wind never raises the thermometer as high as a south-west. These mountains, in the valley of the Mohawk (Lat. 43 °N.), are depressed to the low level of four or five hundred feet — the axis of the depression being east and west. In the valley of Lake Champlain there is a depression, to within one hundred feet of the level of the sea, in a direction from south to north. The long estuary of the St. Lawrence presents a depression to the level of tide-water, running nearly north-east and south-west. These depressions afford avenues for the winds which blow in the direction of their axes.

But the mountains of the western side of the Valley, exert on its climate a far greater influence than those of the east. The Andes may be too remote for effect upon it; but the long and low depression which lies between them and the Cordilleras of Mexico, constituting the Isthmus of Panama, on the south and south-west sides of the Carribean Sea, opens a passage for the winds of the Pacific Ocean into the Gulf of Mexico. Further north, the Cordilleras, the Rocky Mountains, the Californian Maritime Alps, or Sierra Nevada, and the enormously elevated, littoral mountains of the British and Russian Dominions, constitute, from the equatorial to the polar seas, a broad and elevated mountain barrier, with but two depressions, the South Pass, which is eight thousand feet above the ocean, and the valley of the Gila, ten degrees further south, which is four thousand feet. Thus, through its whole length, the influences of the Pacific Ocean are nearly shut off from the great Valley. The difference of level between these mountains and the inclined plane which constitutes the western side of the Valley, no doubt, often causes the descent of their cold air, in the form of temporary winds; and when the atmosphere of the Pacific surmounts them, it comes down upon us, deprived, to a great extent, of both its caloric and its vapor. In this respect, the modifying influence of the Rocky Mountains on our climate, is much greater than that of the Appalachians. Let us now turn to the seas, on which the Valley opens to the south and north.

VII. The Gulf of Mexico subtends the Valley to the south. The southern side of that sea coalesces, by a broad strait, with the Carribean Sea, the southern coasts of which are low, and among the hottest on the globe. Thus, to the south of the great Valley, and projecting into it, as high as the thirtieth degree of north latitude, there is an immense basin of tropical water, from the surface of which come those volumes of hot and humid air, which constitute the southern winds of the Interior Valley. The south-west wind, which advances from or traverses the mountain regions west of the Gulf of Mexico, and also the Rocky Mountains further north, is both dryer and cooler. In summer, it sheds but little moisture on the great prairies; and, from the dry and shadeless condition of their surface, is often so much heated, as to produce occasional hot days very far north. These currents, like those from the Gulf, in making their way to the polar regions, traverse the country around Hudson Bay, and at last reach that in which, as we have seen, the Pole of Cold is situated. Were the Gulf of Mexico rolled away, by an upheaving of mountains in its bed, the climate to its north-east would undergo a signal change; as would that of the whole Valley, if the western mountain chain were sunk, so as to let in the mild and damp atmosphere of the Pacific Ocean.

VIII. To the north, the Valley is subtended by Hudson Bay and the Polar Sea. North of the former and within the latter, lies the Pole of Cold, or region of North America in which the mean temperature of the year is least. It is worthy of remark, that all the southern and south-western winds which can reach this spot, must have descended from or crossed the Rocky Mountains, in latitudes where their crests are covered or embossed with perpetual snow. Without attempting here to assign the fundamental causes of the low temperature of the region of maximum cold, it may be safely affirmed, that if the Rocky Mountains, north of the South Pass, in latitude 42°, were sunk to near the level of the Pacific Ocean, the rigor of the Pole of Cold, would be greatly diminished. By what route the polar air from that icy region, makes it way back to the equator, I cannot say. It certainly does not traverse the Interior Valley, in volumes sufficient to compensate for those which flow in the opposite direction. When it does blow, it is always cold; and thus our Valley, being placed between one of the hottest and one of the coldest seas of the globe, must forever be subject to sudden vicissitudes and wide extremes of temperature.

IX. This brief general view of the elements of our climate, has prepared us for entering on its statistics; which consist of observations made on several different conditions of the atmosphere, at various stations. Before proceeding to examine these elements in detail, we may advantageously consider for a moment their relations and mutual dependence. While the sun constitutes the first cause, or *primum mobile*, of all the phenomena of climate, the whole do not *immediately* depend upon the influence of that orb. By its action on the surface of the continents and seas, it imparts heat to the atmosphere, but in very unequal degrees; and that heat becomes the cause of many effects, or meteorological appearances. These are losses of statical equilibrium, and the production of winds, which transport hot air into colder regions, and cold air into hotter. In the former case its vapor is precipitated in the form of rain or snow; in the latter, it passes into a state of more perfect suspension, and the atmosphere becomes more transparent. In the condensation of vapor, electrical phenomena are produced, and caloric is given out, which raises the temperature of the atmosphere. On the other hand, the evaporation from the earth's surface, and from the objects it supports, after rain, cools the whole. In studying a group of phenomena so complicated, it is necessary to take them up in succession, which we shall now proceed to do.

CHAPTER II.

TEMPERATURE OF THE INTERIOR VALLEY.

SECTION I.

MEAN TEMPERATURE OF THE YEAR.

I. Difficulties of the Subject. — In attempting to ascertain the mean temperature of the atmosphere for each degree of latitude, in the vast Interior Valley of North America, the first difficulty is the want of observations at a sufficient number of places; especially under the same parallels, and to the east and west of the Mississippi, or synclinal axis of the Valley. The second is, that some observers have not made their observations at the hours of the day most proper for showing either its extremes, or its mean heat. The third, that many thermometers have been inaccurate. The fourth, that the positions in which they have been kept, have been differently chosen. Thus, with a few honorable exceptions, the results are but doubtful approximations to the truth. However all this may be regretted, we need not be astonished, for the Valley is too recently and sparsely settled, to have raised up a body of professed meteorologists; and practical physicians are, in general, too much occupied, and too often absent from home, to make and record regular observations. At first view, the registers kept at the various military posts, under the direction of the Surgeon General of the United States' Army, might seem worthy of implicit confidence; but after visiting a considerable number of these posts, I have come to the conclusion, that, from the frequent change of officers, the wrong position of instruments, and other causes, many of the army registers are not as accurate as could be desired. As a class, the registers kept at the academies of Western New York, are probably the most exact, and in general, extend through the greatest number of years.

II. Object to be kept in View. — In studying our thermometrical statistics, we should constantly keep in view the law of decrease of mean temperature, as we advance from south to north; for when *it* may be found out, we can, by calculation, determine the mean temperature of places, at which no observations have been made, and thus construct a table of mean temperatures for every parallel of latitude. Should the ratio of decrease vary, as we proceed from the tropical to the polar regions, the law of variation being ascertained, the calculation might still be made. At present, the number of reliable observations is too few to afford us rigorous results; but the discovery of such a law should be kept in mind as a *desideratum.*

III. Ascertained Mean Temperatures. — We cannot, I suppose, proceed with this subject in a more natural method, than to give in a tabular form all the results which I have been able to collect. In doing this, it will be proper to commence in the equatorial regions, at the level of the sea, where the maximum of heat corresponds to the minimum of latitude and elevation, and thence proceed to the polar regions, where the minimum of heat corresponds to the maximum of latitude. It will be proper, at the same time, to give the altitudes above the Ocean, of the places of observation, and their proximity to, or remoteness from, seas, lakes, and mountains; which, as far as may be practicable and convenient, I shall do. A critical examination of the tables, will soon disclose to the reader, some embarrassing anomalies. He will see a lower mean temperature assigned to a place, than that of a place further north. This may sometimes be explained by difference of altitude; but, in many instances, may be regarded as the evidence of inaccurate observation. Time only can be relied upon for the correction of these errors; which are not peculiar to meteorology, but necessarily belong to all the inductive sciences.

GENERAL TABLE OF MEAN TEMPERATURES,

COMPRISING EIGHTY-TWO PLACES, EXTENDING FROM SOUTH TO NORTH.

No. for reference	PLACES, advancing from South to North.	North Latitude.	West Longitude.	Relation to Seas, Lakes, or Mountains.	Feet Above ocean.	Dates of Observations.	No. of y's	Mean Ann. Temp.	Lowest annual Temp.	Highest annual Temp.	Range of annual Temp.	No. of y's	AUTHORITIES.
	MEXICAN AND ST. LAWRENCE BASINS.	° ′	° ′					°	°	°	°		
1	Equatorial Regions,	10 00	80 00	Coasts of the Carribean Sea,	00	various.	..	82.00	....	....	....	..	Humboldt, and other observers.
2	Cumana, South America,	10 28	64 10	Do.	00	....	1	81.56	....	....	....	..	Humboldt's Tables in Kaemtz's Meteorology.
3	Vera Cruz, Mexico	19 12	96 09	W. Coast of Gulf of Mexico,	00	....	13	77.00	....	....	....	..	" "
4	City of Mexico,	19 26	99 06	Among the Cordilleras,	7451	......	2	61.88	....	....	....	..	" "
5	Xalapa "	19 30	96 54	50 miles west of Gulf, Terrace of the Cordilleras,	4330	......	..	67.64	....	....	....	..	Richardson's Table in Proceedings of British Association.
6	Havana, Cuba,	23 10	82 23	Eastern Coast of the Gulf,	00	1810–12	3	77.34	....	....	....	..	Humboldt's Personal Narrative.
7	Ubajoy, "	23	82	Interior: 15 ms. from Havana,	247	1796–9	4	73.50	71.40	75.20	3.80	4	Robredo, quoted by Humboldt.
8	Key West, Florida,	24 34	81 52	Island: east side of the Gulf,	00	1830–38	9	76.48	75.92	77.54	1.62	6	Met. Register U.S. Army; W. A. Whitehead, Esq.
9	Fort Brooke, Tampa Bay, do	27 57	82 35	East side of the Gulf,	00	1825–44	9	72.40	72.37	74.19	1.82	5	" "
10	Fort King, do	28 58	82 05	50 miles east of Gulf,	50?	......	3	71.57	....	....	....	..	" "
11	New Orleans, Louisiana,	29 57	89 59	North Gulf-Coast	00	1840–2	3	71.32	....	....	....	..	Mr. D. T. Lillie.
"	N. Orleans Barracks, La.	29 57	89 59	Do.	00	......	3	69.60	....	....	....	..	Met. Register U. S. Army.
12	Fort Wood, Louisiana,	30 05	89 41	Do.	00	......	3	68.22	....	....	....	..	" "
13	Fort Pike, or Petite Coquilles, Louisiana,	30 10	89 38	Do.	00	1827–	8	70.38	....	....	....		" "

TABLE OF MEAN TEMPERATURES—CONTINUED.

No. for reference	PLACES, advancing from South to North.	North Latitude.	West Longitude.	Relation to Seas, Lakes, or Mountains.	Feet above Ocean	Dates of Observations	No. of y's	Mean Ann. temp.	Lowest annual temp.	Highest annual temp.	Range of annual temp.	No. of y's	AUTHORITIES.
		° ′	° ′					°	°	°	°		
14	The 30th Parallel and 90th [Meridian,	30 00	99 00	Suburbs of New Orleans,...	00	......	17	70.12	69.28	72.71	3.43	11	Deduced from the four preceding means.
15	Pensacola Bay; U. S. Ma- [rine Hospital, Florida,	30 19	87 16	North Gulf-Coast,.........	00	1830–35	6	68.16	66.18	70.52	4.34	9	Dr. Hulse, Navy Surgeon, & Mr. Smith, Hosp. Steward. Met. Reg. U. S. Army.
16	Pensacola Bay, Cant. Clinch,	30 24	87 14	Do. do. do.........	80?	1822–24	3	68.77					
17	Baton Rouge, Louisiana....	30 36	91 33	Interior: north of Gulf, ...	50?	1822–	7	67.56	65.55	69.27	3.72	..	" " "
18	Mobile, Alabama,.	30 42	87 59	North Gulf-Coast, ...	00	1840–43	4	70.29	69.12	71.21	2.09	4	Dr. Stephen B. North.
19	Fort Jesup, Louisiana, ...	31 30	93 47	Interior: north of Gulf, remote from mountains,	100?	......	17	66.65	65.55	69.27	3.72	7	Met. Reg. U.S. Army.
20	Natchez, Mississippi, ...	31 34	91 28	Do. do. do....	264	1836–47	12	66.86	64.10	67.90	3.80	10	Dr. Henry Tooley.
21	Vicksburg, Mississippi, ...	32 24	91	Do. do. do....	350?	1839–42	4	66.74	....	....	....	..	Mr. N. W. Hatch.
22	Fort Towson, Indian Ter...	33 53	94 13	Do. do. do....	300?	......	7	61.17	....	....	....	..	Met. Reg. U. S. Army.
23	Huntsville, Alabama,......	34 45	....	Interior: near Appalach. Ms.	600?	1829–42	13	59.73	58.05	61.79	3.74	13	Rev. John Allan, *MS. pen. me.*
24	Fort Smith, Indian Territory	35 25	94 49	Remote from ms. and Gulf,	600?	......	2	59.17	....	....	....	..	Met. Reg. U. S. Army.
25	Fort Gibson, " "	35 48	95 04	Do. do. do....	600?	1828–44	11	61.07	60.22	65.06	4.84	3	" " "
26	Nashville, Tennessee, ...	36 10	86 49	Interior: near Appalach. Ms.	600?	1840–44	5	58.46	56.55	59.93	3.38	5	Prof. James Hamilton.
27	Louisville [its vicinity] Ky.,	38 00	85 25	Remote from mountains,....	600?	1841–46	6	55.00	51.50	56.50	5.00	6	Mr. L. Young.
28	New Harmony, Indiana,....	38 11	86 50	Do. do. do....	340	1826–29	3	56.69	....	....	....	..	Prof. G. Troost.
29	Jefferson Barracks, Mo.,..	38 28	90 08	Do. do. do....	440?	......	8	56.93	55.51	59.27	3.73	4	Met. Reg. U. S. Army.

30	St. Louis, " ...	38 37	90 16	Do. do. do.	450	1833–48	16	55.55	51.92	57.73	5.81	16	D. G. Engelmann, *MS.pen.me.*
"	Do. " ...	38 37	90 16	Do. do. do.	....	....	4	54.77	....	....	....	..	Dr. B. B. Brown.
31	Portsmouth, Ohio, ...	38 45	82 56	Do. do. do.	540	1824–46	20	55.36	51.75	57.72	5.97	20	Dr. G. S. B. Hempstead.
32	Cincinnati, "	39 06	84 29	Do. do. do.	543	1806–13	8	54.25	52.65	56.60	5.47	21	Col. J. Mansfield & Dr. D.Drake in Pict. of Cincinnati.
,,	Do. "	39 06	84 29	Do. do. do.	....	1835–47	13	53.36	51.13	55.37			Prof. Jos. Ray, *MS. pen. me.*
33	Ft. Leavenworth, Ind. Ter.	39 23	94 44	Do. do. do.	912	....	5	52.34	....	....	....	..	Met. Reg. U. S. Army.
34	Marietta, O., ...	39 25	81 31	Do. do. do.	630	1818–47	26	52.81	50.03	55.62	5.59	26	Dr. S. P. Hildreth, *MS. pen. me.*
35	Washington, Pennsylvania,	40 22	81 28	Interior: near Appal'n Ms.,	1100?	1826–29	6	53.13	48.55	57.90	9.35	6	Dr. S. S. Reed, *MS. pen. me,*
36	Steubenville, O., ...	40 25	80 41	do. do. do.	670	1833–45	12	50.83	49,00	55.33	6.33	12	Mr. Roswell Marsh.
37	Hudson, O., ...	41 15	82 28	South of Lake Erie, 25 miles,	1131	1838–40	3	47.30	....	....	....	..	Prof. E. Loomis.
38	Bloomington, Iowa, ...	41 26	91 10	Interior: remote from moun's,	560?	1839–45	9	49.30	44.50	55.70	11.20	9	Mr. T. S. Parvin.
39	Council Bluffs, Ind. Ter...	41 28	95 45	Do. do. do.....	1127	1822–26	5	51.08	48.68	51.80	3.12	5	Met. Reg. U. S. Army.
40	Ft. Armstrong, Rock Isl., Ill.,	41 32	89 42	Do. do. do.....	580	1827–	6	50.65	....	....	....	..	" " "
41	Fort Dearborn, Chicago, Ill.	41 50	87 55	West Coast Lake Michigan,	591	....	2	46.14	....	....	....	..	" " "
42	Cuba, New York, ...	42 15	78 30	S. Lake Erie, moun. terrace,	1502	1841	1	41.44	....	....	....	..	Regent's Reports Un. of N. Y.
43	Detroit, Michigan, ...	42 19	82 58	Bet'n. L. Erie and L. Huron,	578	....	4	47.43	46.88	48.93	2.05	4	Met. Reg. U. S. Army; Rev. George Duffield.
44	Fredonia, New York, ...	42 26	79 21	South shore of Lake Erie, ..	708	1830–46	16	48.85	44.54	51.22	6.68	14	Regent's Reports Un. of N. Y.
45	Springville, "	42 30	78 50	20 ms. east of L. Erie, ...	1064	1838–43	4	44.85	42.41	48.31	5.90	8	" " " "
46	Franklin Academy, Pratts-[burg, New York,	42 34	77 20	South of L. Ontario 50 ms., [near Appalch. Mountains,	1494	1839–43	5	42.83	35.81	46.95	11 14	6	" " " "
47	Cayuga, "........	42 43	76 37	Do. do. do.	447	1830–46	12	48.69	43.05	50.51	7.46	10	" " " "

TABLE OF MEAN TEMPERATURES—CONTINUED.

No. for ref'rence	PLACES, advancing from South to North.	North Latitude.	West Longitude.	Relation to Seas, Lakes, or Mountains.	Feet above Ocean	Dates of Observations.	No. of ys.	Mean Ann. temp.	Lowest Ann. temp.	Highest Ann. temp.	Range of Ann. temp.	No. of ys.	AUTHORITIES.
48	MIDDLEBURY, New York,....	42 49	78 10	S. of L. Ontario, 35 ms, ...	800	1826–46	17	46.58	42.13	49.62	7.49	15	Regent's Rep. of Un. of N. Y.
49	CANANDAIGUA, "	42 50	77 15	Do. do. 30 "	813	1826–39	12	46.01	42.92	48.86	5.94	8	" " " "
50	FORT GRATIOT, Michigan....	42 51	82 53	South end of Lake Huron,..	600	....	5	46.83	....	....	....	..	Met. Reg. U. S. Army.
51	POMPEY, New York,........	42 56	76 05	S. of L. Ontario, 40 ms., ...	1300	1826–43	17	42.84	40.62	47.33	7.31	13	Regent's Rep. of Un. of N. Y.
52	ONONDAGA, New York,......	42 59	76 06	Do. do. " "	450	1826–44	16	47.11	44.02	50.90	6.88	12	" " " "
53	MONROE, "	43 00	77 51	Do. do. 16 "	600	1835–39	3	45.84	....	....	....	..	" " " "
54	FORT CRAWFORD, Prairie DuChien, Wisconsin,	43 03	91 09	Interior: west of L. Michigan	690	....	11	47.35	....	....	....	..	Met. Reg. U. S. Army.
55	MILWAUKIE, " ..	43 03	87 48	West shore of L. Michigan,	600	1843–44	1	47.60	....	....	....	..	Dr. E. S. Marsh, *MS. pen. me.*
56	ROCHESTER, New York,....	43 07	77 51	South of Lake Ontario 10 ms,	506	1830–46	15	46.68	43.71	49.27	5.56	15	Regent's Rep. of Un. of N. Y.
"	Do. "	....	....	Do. do. do.--	....	1835–47	13	46.30	....	....	....	..	Mr. L. Wetherill.
57	LEWISTON, "	43 09	77 10	South bank of Lake Ontario,	280	1831–46	15	48.00	44.50	50.70	6.20	11	Regent's Rep. of Un. of N. Y.
58	MEXICO, (formerly Rensselaer, Oswego), New York,	43 27	76 14	South of Lake Ontario 4 ms,	331	1837–46	8	44.21	42.95	46.86	3.91	8	" " " "
59	FORT WINNEBAGO, Wisconsin,	43 31	89 28	Interior: west of L. Michigan,	800	....	5	44.89	....	....	....	..	Met. Reg. U. S. Army.
60	LOWVILLE, New York, ...	43 47	75 33	Int. bet'n Lake Ontario and [Adirondack Mountains,	800	1828–45	16	43.61	39.72	46.95	7.23	16	Regent's Rep. of Un. of N. Y.
61	MADISON BARR., Sackett's Harbor, New York,	43 57	76 04	East bank of Lake Ontario,	250	....	3	46.54	....	....	....	..	Met. Register of U. S. Army.
62	POTTSDAM, St. Lawrence Academy, New York,	44 40	75 01	Interior: N.W. Adirondack Ms.	394	1828–46	19	43.47	40.57	46.01	5.44	18	Regent's Rep. of Un. of N. Y.
63	FORT HOWARD, Green Bay, Wisconsin,	44 40	87 00	Head of Green Bay, 50 ms west of Lake Michigan,	600	1822–	17	44.60	42.38	46.70	4.32	9	Met. Register of U. S. Army.

64	PENETANGUISHINE, Canada W.,	44 48	80 40	Georgian Bay of Lake Huron,	600	......	..	45.16	....	....	....	..	Richardson's tab.; Pro. Br. Asso.
65	FT. SNELLING, Minisota Ter.	44 53	93 05	Interior: west of L. Michigan	780	1822–	18	45.15	43.17	48.60	5.43	8	Met. Reg. U. S. Army.
66	MONTREAL, Canada East.....	45 31	73 34	Int. north of Adirondack Ms.	50	1826–40	15	44.57	40.43	47.80	7.37	15	Mr. J. S. McCord.
67	FORT MACKINAC, Michigan...	45 51	85 05	Island: Lake Huron,........	728	1826–00	6	40.02	....	....	....	..	Met. Reg. U. S. Army.
68	FORT BRADY, " ...	46 30	84 43	Bet. L. Superior & L. Huron,	600	1823–	15	40.62	39.66	43.52	3.86	6	" " "
69	QUEBEC, Canada E., interior, north of Adirondack Ms	46 49	71 16	Lower Town, ...	000	......	..	41.74					Riahardson's Tab.
				Up. Town, Old Par. House,	100	1845–47	3	41.88	....	....	....	..	Ms. Reg. kept at Old Par. House, copied by Mr. J. Smith.
				Cape Diamond, the Citadel,	330	1829–36	8	37.66					Watt in Daubeny's Tab. Pro. B. As.
	HUDSON AND POLAR BASINS.												
70	CUMBERLAND HOUSE,........	53 57	102 17	Eq'dis. Rocky Ms. & Hudson B.	800	......	..	32.01	....	....	....	..	Richardson's table.
71	NAIN, Labrador,...........	57 08	61 20	West Coast Davis's Straits,..	00	......	3	26.28	....	....	....	..	" "
72	FORT CHIPEWYAN,.....	58 43	111 18	Equidistant between Rocky Mountains & Hudson Bay,	500	1820–3	..	29.19	....	....	....	..	" "
73	FORT CHURCHILL,..........	59 02	92 05	West Coast of Hudson Bay..	00	......	..	25.20	....	....	....	..	" "
74	FORT SIMPSON,.............	62 11	121 32	Near the Rocky Mountains,.	78	......	2	27.50	....	....	....	..	Humboldt's tab. in Kaem. Met.
75	FT. RELIANCE, Gt. Slave Lake,	62 46	109 06	Equidistant bet. Rocky Ms, Hudson B., & Polar Sea.	350	1833–5	2	21.47	....	....	....	..	Back's Narrative, Am. Ed.
76	FORT ENTERPRISE,..........	64 28	113 06	Do. do. do. do....	850	1820–3	1	14.19	....	....	....	..	Richardson's Table.
77	FT. FRANKLIN, G't Bear Lake,	65 12	123 13	Near Rocky Ms. & Polar Sea,	200	1820–3	2	17.24	....	....	....	..	" "
78	WINTER ISLAND, — off Melville Peninsula,	66 11	83 11	North of Hudson Bay,......	00	1821–2	1	6.09	....	....	....	..	Parry's Second Voy., Am. Ed.,
79	IGLOOLIK "	69 20	81 53	Do. do. do......	00	1822–3	1	2.50	....	....	....	..	" " " " "
80	FELIX HARBOR, Polar Sea,...	70 00	91 53	Gulf of Boothia,...........	00	1829–33	3	3.76	....	....	....	..	Ross' Second Voy., Am., Ed.
81	PORT BOWEN, " ...	73 14	88 55	Prince Regent's Inlet,......	00	1819–20	1	3.62	....	....	....	..	Richardson's Table.
82	MELVILLE ISL'D, (Winter H.)	74 47	110 48	Polar Sea,................	00	1819–20	1	–1.07	....	....	....	..	Mean of Richardson's, Murray's, Muller's, & Humb. tab.

IV. Law of decrease of Mean Temperature from increase of Latitude.— M. Humboldt informs us, that the equatorial mean heat of 82° extends north, to Lat. 10°. Melville Island, the most northen station of the table, lies 64° 47′ further north, and has a mean temperature 83° .07 less, which, divided by the difference of latitude, gives 1° .28 as the reduction of temperature caused by each degree of latitude, from the equatorial to the polar regions inclusive. If this ratio were uniform, it would be easy, by making allowance for the differences of elevation, to calculate the mean temperature of any given place. But the ratio varies in a remarkable manner, and to this point we must now give attention.

From Cumana to Havana the distance is 12° 42′, and the reduction of temperature 4° .22, which gives a decrement of .33 (thirty-three hundredths) of a degree of temperature for every degree of latitude.

Between Key West and Fort Brooke, the difference of latitude is 3° 23′, of temperature 4° .08, which gives a ratio of 1° .20.

Between Fort Brooke and the thirtieth parallel the difference of latitude is 2° 03′—of temperature 2° .28, affording a ratio of 1° .11.

The difference in latitude between Key West and the thirtieth parallel, near New Orleans, is 5° 26′—that of temperature 6° .36, from which results, as the ratio 1° .17 of reduced heat for a degree of latitude. This ratio, which is nearly identical with that of the whole range, is about three times as great as the ratio from the equatorial limit to Key West.

From Key West to St. Louis, the distance is equal to 14° 03′—the difference in mean heat 21° .12, giving a ratio of 1° .50; but when we subtract from the difference of temperature 1°, for the elevation of St. Louis above the sea, the ratio falls to 1° .43.

Between Natchez and Huntsville, the latitude is 3° 11′, and the difference of mean heat 7° .13, which gives a ratio of 2° .28. But as the latter rises, gradually, four hundred feet above the former, one degree must be deducted from the whole difference, when the ratio is reduced to 1° .92.

From Huntsville to Nashville 1° 25′; difference of mean heat 1° .27; ratio 0° .90. The elevation of both places nearly the same.

When we compare Natchez and Nashville, having a difference of latitude equal to 4° 36′, and of mean temperature equal to 8° .40, we obtain as the ratio 1° .82. The difference of altitude between these places, is from three hundred to four hundred feet, and the rise gradual, so that we may deduct a degree from the difference in their mean temperature, as the effect of greater elevation, when the ratio of reduction is diminished to 1° .60.

On comparing the thirtieth parallel, near New Orleans, with Natchez, the latter being 1° 34′ north of the former, and having a mean temperature 3° .26 lower, we find that the ratio of reduction is 2° .08 of mean temperature for 1° of latitude. The elevation of Natchez over (the thirtieth parallel near) New Orleans, is two hundred and sixty-four feet; and if we allow 0° .66 of the difference in temperature, to result from that cause, we have a ratio of decrease equal to 1° .66 for a degree of latitude; which is a rate of reduction greater, by .72, than that from Key West to the thirtieth parallel, at New Orleans.

Between Natchez and St. Louis the difference of latitude is 7° 3′, the difference of mean temperature 11° .50, which gives a ratio of 1° .63 for a degree of latitude. If we make the allowance of one-third of a degree for the difference of elevation, about one hundred and thirty-three feet, we have a ratio of 1° .58.

Between Nashville and St. Louis the difference of latitude is 2° 27′—of mean temperature 3° .10, giving a ratio of 1° .26; but as Nashville is about two hundred feet the higher of the two, by a gradual ascent, half a degree must be added to its mean temperature, when the ratio of decrease from latitude becomes 1° .17.

Between Nashville and Cincinnati, at nearly the same level, the difference of latitude is 2° 56′—of mean temperature 4° .86, which data give 1° .69 as the ratio.

Fort Armstrong, with an elevation, by gradual ascent, of about one hundred and eighty feet above St. Louis, and a higher latitude of 2° 55′, has a mean temperature 4° .92 less. According to these data, the ratio of decrease is 1° .69. If we allow for the difference of altitude, the ratio is reduced to 1° .51.

Fort Crawford (Prairie du Chien) lies 4° 26′ north of St. Louis, and three hundred feet above its level; their difference in mean temperature is 8° .01, giving a ratio of 1° .80. As they differ in elevation, by gradual ascent, three hundred feet, we must subtract .75 (three quarters of a degree) from the difference between their temperatures, when the ratio is reduced to 1° .63.

Fort Snelling lies 6° 15′ north of St. Louis, at an elevation, by slow ascent, three hundred and eighty feet higher; the difference in their mean temperature is 10° .21, from which results the ratio 1° .62; but when we equalize their elevation, the ratio falls to 1° 47.

The elevation of Portsmouth and Rochester is nearly the same; the difference in their latitude is 4° 22′—in their mean temperature, 8° .94, which gives a ratio of 2° .04.

Cincinnati and Rochester have the same elevation, and differ in latitude 4° 1′. The difference in their mean temperature is 7° .38, which gives a ratio of 1° .83.

The difference in elevation between Marietta and Rochester, is too little to require attention; their difference of latitude is 3° 42′, of mean temperature 6° .39, from which results the ratio 1° .73.

From Cincinnati to Fredonia, the change of latitude is 3° 20′; the difference in mean temperature is 4° .95, and consequently the ratio of diminution is 1° .48. If we make allowance for the difference of elevation, about one hundred and sixty feet, say .45, or near half a degree, the ratio is reduced to 1° .35.

The difference of latitude between Cincinnati and Pompey, is 3° 50′—of abrupt elevation eight hundred and sixty feet—of mean temperature 10° .96, from which results a ratio of 2° .85; but when we allow 4° of temperature, for the difference of altitude, the ratio is reduced to 1° .81.

Between Rochester and Montreal, the difference of latitude is 2° 24′—of mean temperature 1° .85, giving a ratio of only .77—little more than three quarters of a degree; but Montreal lies near five hundred feet below Rochester, for which we must add to the difference in temperature, about a degree and a quarter, when the ratio is raised to 1° .29.

Fort Brady lies 4° 04′ north of Fredonia, and the difference of their mean temperature is 8° .23, which gives a ratio of 2° .02. As Fredonia is one hundred and thirteen feet higher than Brady, we must add to the difference between them, about one-third of a degree (.33), when the ratio is raised to 2° .10.

The distance north, from Rochester to Fort Brady, is 3° 23′—the difference of elevation only ninety feet; the range of mean temperature 5° .80. Disregarding the difference of altitude, the ratio of decrease is 1° .71.

Fort Howard lies 6° 03′ north of St. Louis, and the difference in their mean temperature is 10° .76, which gives a ratio of 1° .78; but the greater elevation (near two hundred feet) of the former requires the deduction of (.50) half a degree, when the ratio is brought down to 1° .69.

Fort Winnebago lies 4° 54′ north of St. Louis, and is 10° .47 colder, consequently the ratio of decrease of temperature, is 2° .14; but as its elevation is four hundred feet greater, by gradual rise, we must subtract a degree from the difference, when the ratio is reduced to 1° .93.

From Fort Howard to Fort Brady, the distance in latitude is 1° 50′—the difference in mean temperature 3° .98, giving a ratio of 2° .17. The difference in elevation is too small to require notice.

Cumberland House is in N. Lat. 53° 57′, or 15° 20′ north of St. Louis; the difference in their mean temperature, is 23° .35, from which results, as the ratio of decrease, 1° 52; but as the former has four hundred feet of greater altitude, by gradual rise, a degree must be deducted from their difference, which reduces the ratio to 1° .46.

The distance from Fort Snelling to Cumberland House, in latitude, is 9° 04′; the difference of mean temperature is 13° .14, giving a ratio of 1° .45, the elevations being nearly the same.

From Cumberland House to Fort Chipewyan, N. Lat. 58° 43′, the distance is 4° 46′—the difference of mean annual heat 2° .82, affording a ratio of 0° .4. As the latter is three hundred feet lower, .75, or three-fourths of a degree, must be added to the difference of temperature, when the ratio becomes, .75, or three quarters of a degree.

Fort Reliance, or Resolution, in latitude 62° 46′, lies 4° 03′ north of Fort Chipewyan, and the difference of their mean annual temperatures is 7° .72, which gives a ratio of 1° .90. As the latter is one hundred and fifty feet the higher, .37 must be added to the difference, when the ratio is increased to 1° .99.

Fort Enterprise, in latitude 64° 28′, lies 1° 42′ north of Fort Reliance, and their difference of temperature is 7° .28, giving a ratio of 4° .28. As the former is five hundred feet higher than the latter, a deduction must be made from the difference of temperature of a degree and a quarter, when the ratio is reduced to 3° .54.

Melville Island, in latitude 74° 47′, lies 12° north of Fort Reliance, and has a mean temperature 22° .54 lower, which indicates a ratio 1° .88. As the latter is three hundred and fifty feet more elevated, 87 hundredths of a degree must be added to the difference, when the ratio rises to 1° .95.

From Fort Churchill to Melville Island, the distance is 15° 45′ of latitude—the difference of mean temperature 26° .27—the ratio 1° .67; both stations being at the level of the sea.

Fort Franklin is 6° 10′ north of Fort Churchill, and two hundred feet more elevated; the difference in their mean heat is 7° .96; the ratio of decrease 1° .29. The ratio, when they are reduced to the same level, is 1° .21.

From Fort Franklin to Melville Island, the latitude is 9° 35′—the difference of temperature 18° .31; the ratio 1° .94. The greater elevation of the former, two hundred feet, requires half a degree to be added to the difference, when the ratio rises to 1° .96.

Fort Churchill lies 12° 32′ north of Fort Brady, and has a temperature 15°.42 less; but as it is six hundred feet lower, the difference must be increased 1°.5, making it 16°.92, when the ratio is 1°.35.

From Fort Snelling to Fort Churchill 14° 09′ of latitude — difference of mean heat 19° .85—ratio 1° .40. As the difference of elevation in favor of Snelling is seven hundred and eighty feet = 2° must be added to the difference of temperature = 21° .85 — giving a ratio of 1° .54.

From Fort Churchill to Winter Island, the range is through 7° 09′ of latitude; the difference of mean heat, 19° .11; the ratio (both at the level of the sea) 2° .67.

Igloolik lies 10° 18′ north of Fort Churchill, and has a mean temperature 22°.70 less, with a consequent ratio of 2°.20. Both at the level of the sea.

From Fort Churchill to Victoria, or Felix Harbor, 10° 58′ of latitude; 21° .44 of difference in temperature; ratio 1° .96.

From Nain, N. Lat. 57° 08′, to Winter Island, distance 9° 03′ of latitude—difference of temperature, 20° .19; ratio 2° .23.

Nain to Victoria, or Felix Harbor, 12° 52′ of latitude—difference of mean heat 22° .52—ratio 1° .75.

Winter Island to Igloolik 3° 09′ of latitude—difference of mean heat 3° .59—ratio 1° .14.

Melville Island lies 4° 47′ north of Felix Harbor—difference of temperature 4° .83—ratio 1° .01.

Winter Island to Port Bowen, difference of latitude 7° 03′—of mean heat 2° .47—ratio 0° .35.

Felix Harbor to Port Bowen 3° 14′—difference of temperature 1° .26—ratio 0° .39.

Igloolik to Port Bowen, distance 3° 54′—difference of temperature in favor of the latter, though further north, 1° .12; ratio of *increase* of temperature 0° .30.

V. Law of decrease of Mean Temperature, from Altitude—In examining the elevations given in the preceding table, we do not find sufficient data for determining the ratio at which the thermometer falls, as we ascend from the level of the sea. Of the eighty-two stations, many are at or near that level, and but six rise above a thousand feet. The greater number are below five hundred. Let us select such places, lying nearly in the same latitude, as admit of being compared.

Vera Cruz, at the level of the sea, in N. Lat. 19° 12′, has a mean temperature of 77°. Xalapa, situated 20′ further north, ought to have a temperature of 76° .73; but observation has made it 67° .64, or 9° .36 less than what its latitude demands. Now the elevation of Xalapa over Vera Cruz, is four thousand three hundred and thirty feet, and to this elevation we may ascribe the difference. By dividing the difference of altitude by the difference of temperature, we obtain four hundred and sixty-seven feet as the ratio for 1° of temperature. Again, the difference of mean temperature between Vera Cruz and the City of Mexico, their latitudes being nearly the same, is 15° .12, while the latter is elevated seven thousand four hundred and fifty-one feet over the former; which gives four hundred and ninety-three feet, for 1° of reduced annual heat.

Fort Armstrong and Council Bluffs, in mean latitude 41° 30′, but distant from each other more than 5° of longitude, present the anomaly of a mean temperature nearly half a degree (.43) higher at the Bluffs, which have an altitude five hundred and forty-seven feet greater than Fort Armstrong.

Marietta and Fort Leavenworth, in mean latitude 39° 24′, but 13° of longitude apart, differ in their elevation three hundred feet; but in their mean temperature vary less than half a degree (.47).

The region on the south side of Lake Ontario, furnishes several data, on which greater reliance may be placed.

Cayuga and Springville are 13′ of latitude apart, and when allowance is made for this, the difference in their mean temperature is 4° .20; but their difference in altitude, is six hundred and seventeen feet, which, divided by the difference of temperature, gives one hundred and forty-seven feet as the ratio for 1° of temperature.

Onondaga and Pompey, in the same latitude, differ in mean temperature 4° .27—in altitude eight hundred and fifty feet; which gives a ratio of two hundred feet.

Fredonia and Cayuga, in the same latitude, vary 4° in temperature, and three hundred and fifty-six feet in elevation, which gives a ratio of eighty-nine feet.

Hudson and Fredonia, when the effect of difference of latitude is corrected, vary in mean temperature 3° .50, and differ in altitude four hundred and twenty-three feet, which gives a ratio of one hundred and twenty-one feet.

Lowville and Lewiston, allowance being made for difference of latitude, vary in mean temperature 3° .24, and in elevation five hundred and twenty-eight feet, which affords a ratio of one hundred and sixty feet.

Rochester and Pompey, when correction is made for the difference of latitude, vary in mean temperature 3° .88; the difference in their elevation is seven hundred and ninety-four feet, from which results a ratio of two hundred and five feet.

This is a more rapid reduction than Humboldt has assigned. In the temperate zone, according to that celebrated philosopher,* through an elevation of three thousand feet, the mean heat decreases 1° of Fh. for every two hundred and fifty-three feet of ascent. It is well known, however, that in places having the same latitude, the ratio of decrease varies in a remarkable manner, from the influence of local causes, and the course of the winds, so that no uniform expression of the amount can be fixed; † of which we have sufficient evidence in the few observations embraced in this article. Thus, while on the south side of Lake Erie and Lake Ontario, we have the result just given, we find in the Valley of the Mississippi results of a very different kind. In all the observations which have been quoted, much allowance, however, should doubtless be made for the inaccuracy of thermometers, and the inexactness of ordinary observers. Nevertheless, after having done this, we must admit, that the gradual ascent, from the beds of the Ohio and Mississippi to Fort Leavenworth and the Council Bluffs, and the boundless plains which surround those posts, probably exerts an influence in counteracting the effect of elevation.

In the absence of data for a rigid determination of the influence of altitude, in the reduction of the mean heat of our climates, I shall assume two hundred feet for one degree, in those portions where the elevations are abrupt; and four hundred feet for the great inclined plain, between the Mississippi and the Rocky Mountains, up which the ascent is so gradual, that the surface appears to the eye to be horizontal. These ratios can by no means be regarded as anything more than loose approximations; but they will not be without their utility, when we desire to estimate the mean temperature of a place where thermometrical observations have not been made, by applying to it the results of observation at a neighboring place in the same latitude, but having a different elevation. Thus, for example, we know the mean annual heat of Fredonia, on the southern shore of Lake Erie, in latitude 42° 26′, to be 48° .85, the altitude of the place of observation being seven hundred and eight feet; but we do not know the temperature of the neighboring region around Chautauque Lake, the elevation of which is about one thousand five hundred feet. But if we divide the difference, eight hundred feet, by two hundred feet, the quotient, 4°, subtracted from 48° .85, gives us 44° .85 as the mean temperature of the upper table.

Again, as the mean temperature of Marietta, in latitude 39° 25′, at the elevation of six hundred feet above the sea, is 52° .81, if the average hight

* Edin. Encyclop. of Geography: Vol. I, Art. Meteorology.

† Kaemptz's Course of Meteorology.

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of the Appalachian chain, in the same latitude, be taken at two thousand feet, the difference, one thousand four hundred feet, corresponds to 7°, which subtracted from 52° .81, gives 45° .81 as the mean annual heat of those mountain tops.

When we turn to Fort Leavenworth, in latitude 39° 22′, at an elevation of nine hundred and twelve feet, we find the mean temperature 52° .34. An inclined plain stretches eastwardly from the Rocky Mountains. If the ascent on this plain for five thousand feet give a reduction of 1° of mean temperature for every four hundred feet of elevation, the result is 12° .50; if for the next five thousand feet of mountain elevation, two hundred feet give one degree, the result is 25°, equal to 37° .50, which, subtracted from 52° .34, indicates 14° .84 as the mean annual heat of those summits.

VI. Calculated Mean Temperatures.—From the foregoing data I have constructed the following theoretical table of mean temperatures. In making the calculation, three decrements of temperature, each the mean term of several ascertained ratios of diminution of heat from increase of latitude, have been employed. *First:* For the portion which lies between the equatorial belt, N. Lat. 10°, and the tropic, Lat. 23° 30′, the decrement is 0° .33 (thirty-three hundredths of a degree) of mean temperature, for one degree of latitude, and 0° .0055 for a minute. *Second:* From the Tropic of Cancer to the thirtieth parallel, which cuts the northern margin of the Gulf of Mexico, and passes over the northern suburb of the city of New Orleans, the decrement for a degree of latitude is 1° .16 of mean temperature (one degree sixteen hundredths), and 0°. 0193 for every minute; the stations being, like the last, at the level of the sea. *Third:* From the thirtieth to the forty-eighth parallel, the decrement is 1° .655 mean temperature (one degree six hundred and fifty-five thousandths) for every degree of latitude, and 0° .0276 for every minute; the assumed elevation being six hundred feet above the level of the sea—that which supports the densest stratum of our population. *Fourth:* For the few places which lie far in the north, a separate table has been found necessary.

TABLE OF CALCULATED MEAN ANNUAL TEMPERATURES.

Ratios.		N. L.	M. T.	Ratios.		N. L.	M. T.
Level of the Sea.	Ratio of decrease of Temperature—for 1° of Latitude, 0°.33—for 1′ of Latitude, 0°.0055.	10° 00′	82° .12	Average Altitude of Six Hundred Feet.	Ratio of decrease of Temperature—for 1° of Latitude, 1°.655—for 1′ of Latitude, 0°.0276.	30° 30	69° .29
		11 00	81 .79			31 00	68 .46
		12 00	81 .46			31 30	67 .63
		13 00	81 .13			32 00	66 .80
		14 00	80 .80			32 30	65 .97
		15 00	80 .47			33 00	65 .14
		15 30	80 .31			33 30	64 .31
		16 00	80 .14			34 00	63 .48
		16 30	79 .97			34 30	62 .65
		17 00	79 .81			35 00	61 .82
		17 30	79 .64			35 30	60 .99
		18 00	79 .48			36 00	60 .16
		18 30	79 .31			36 30	59 .33
		19 00	79 .15			37 00	58 .50
		19 30	78 .98			37 30	57 .67
		20 00	78 .82			38 00	56 .84
		20 30	78 .65			38 30	56 .01
		21 00	78 .49			39 00	55 .18
		21 30	78 .32			39 30	54 .35
		22 00	78 .16			40 00	53 .52
		22 30	77 .99			40 30	52 .69
		23 00	77 .83			41 00	51 .86
Level of the Sea.	Ratio of decrease of Temperature—for 1° of Latitude, 1°.16—for 1′ of Latitude, 0°.0193.	23 30	77 .66			41 30	51 .03
		24 00	77 .08			42 00	50 .20
		24 30	76 .50			42 30	49 .37
		25 00	75 .92			43 00	48 .54
		25 30	75 .34			43 30	47 .71
		26 00	74 .76			44 00	46 .88
		26 30	74 .18			44 30	46 .05
		27 00	73 .60			45 00	45 .22
		27 30	73 .02			45 30	44 .39
		28 00	72 .44			46 00	43 .56
		28 30	71 .86			46 30	42 .73
		29 00	71 .28			47 00	41 .90
		29 30	70 .70			47 30	41 .07
		30 00	70 .12			48 00	40 .24

VII. RATIOS OF DECREASE OF TEMPERATURE ABOVE THE FORTY-EIGHTH DEGREE OF LATITUDE. — The places, lying far in the north, at which observations have been made, may be thrown into two groups, as they lie to the east or west of the one hundredth meridian. They are embraced in the following table, which shows for each station the rate of decrease of temperature from the forty-eighth parallel, according to observation:

RATIOS OF DECREASE OF MEAN TEMPERATURE FROM THE FORTY-EIGHTH DEGREE OF N. LAT. TO THE UTMOST LIMIT OF OBSERVATION.

Continental Stations west of the one hundredth meridian, in the direction of the Rocky Mountains.		Littoral and Insular Stations, lying (with the exception of Melville Island) east of the one hundredth meridian.	
To Cumberland House, . . .	1° .37	To Fort Churchill, ...	1° .00
Fort Chipewyan, ...	1 .03	Winter Island, ...	1 .88
Reliance, ...	1 .30	Igloolik, ...	1 .77
Simpson, ...	0 .90	Felix Harbor, ...	1 .67
Enterprise, ...	1 .60	Port Bowen, ...	1 .45
Franklin, ...	1 .34	Melville Island, ...	1 .54
Mean Ratio,	1 .25	Mean Ratio,	1 .55

It appears from these results, that the increase of cold in going north, from the forty-eighth parallel, over Hudson Bay, to the Polar Sea, is at a greater ratio, by thirty hundredths, than in going north, from the same latitude, in a line nearly parallel, and much nearer, to the Rocky Mountains. The course of the latter series of stations, varies many degrees west from north, and comes out to the Polar Sea, not very far east of Behring's Straits; that of the former follows the magnetic meridians, and terminates in the pole, or maximum of cold, between the head of Baffin Bay and Melville Island, about 30° of longitude further east. Thus, with the exception of the summits of the northern extremity of the Rocky Mountains, the coldest part of the continent of North America is that which lies between Hudson Bay and Lancaster Sound. Within these limits is spread out that desolate region aptly called the "Barren Ground;" while the ices of the sounds and straits beyond, have baffled the skill and enterprise of every navigator. The northern limit of the temperate zone, in this region, has a mean annual heat of 5°; its southern limit, on the coasts of the Gulf of Mexico, enjoys a heat of 77°; thus, in traversing the zone, through 43° of latitude, the annual mean temperature sinks 72°, or 1° .67 reduction of annual heat for every degree of latitude. But if we traverse the zone, in a direction parallel to the Rocky Mountains, that is, on the great Missouri plain, and pass Fort Franklin, in the valley of Mackenzie River, the lowering of the annual heat is only 61°, giving a ratio of 1° .42 as the reduction of temperature for each degree of latitude.

VIII. FURTHER USE OF THE FOREGOING TABLES. — Although these tables present only approximations to the truth, they will not be found useless to those who live in places where no thermometrical observations have been made. Should the reader wish by their aid to determine (approximately) the mean temperature of any particular spot, he must know its latitude, and, if it be beyond the forty-eighth parallel, its longitude, and in all cases its probable elevation above the level of the sea; when, by a resort to the ratios of the table, he can readily make the calculation. In the first section (within the tropics) one minute of latitude diminishes the temperature 0° .0055 (fifty-five ten thousandths of a degree), which being multiplied by the number of minutes which his station lies above any given latitude of the table, will show him what deduction to make from the temperature of that latitude. For example, the temperature of the twentieth parallel, is 78° .82; if it be required to know the temperature of N. Lat. 20° 45′, the ratio for one minute, .0055, must be multiplied by 45′, which gives .25, which being subtracted from 78° .82, leaves 78° .57 as the amount sought.

In the second section of the table, the ratio of 1° .16 for a degree of latitude, gives 0° .0193 (one hundred and ninety-three ten thousandths of a degree) for every minute; which must be, as in the other case, multiplied by the number of minutes of any particular station above a given parallel, and the product subtracted from the temperature of that parallel.

In the third section of the table, a degree of latitude reduces the mean heat 1° .655, which is, for each minute, 0° .0276 (two hundred and seventy-six ten thousandths), to be multiplied, as in the other cases, by the number of minutes from the nearest parallel below, and the amount subtracted from the heat of that parallel.

But in all cases allowance must be made for the difference of altitude. In the first two sections of the table, the ratios refer to the level of the sea; in the third, to an average elevation of six hundred feet. Let us take an example. Pompey, in N. Lat. 42° 56′, has, from observation, a mean temperature of 42° .84, which is 6° .03 less than that from calculation; but the altitude of Pompey, one thousand three hundred feet, or seven hundred feet above the average, reduces its temperature 3° .50, and this being added to the temperature from observation, raises it 46° .34.

IX. Atmospheric and Terrestrial Mean Temperatures Compared.—Whatever may be the reality of internal, terrestrial fires, we cannot doubt, that the relative temperature of the crust of the earth, in different latitudes, not less than that of the atmosphere, is largely attributable to the sun. It is now well known, that the influence of that luminary, in the torrid and temperate zones, extends to the depth of eighty or one hundred feet. Through that depth, the summer and winter temperatures vary from each other. The maximum of this variation is found at the surface; its minimum at the depth just mentioned, where lies the plane of invariable heat. From this plane, the temperature increases, at the ratio of one degree of Fahrenheit for about every forty feet of descent. It is only, however, in the middle latitudes, that the mean temperatures of the air and earth coincide. In the south, that of the former is greater—in the north, that of the latter. Hence the curves of terrestrial and atmospheric mean temperature decussate in the temperate zone, at an exceedingly acute angle. It follows from these facts, that to determine the atmospheric mean heat, by that of the crust of the earth, we must, in the southern latitudes, add to the latter—in the northern, subtract from it; but a sufficient number of observations have not yet been made, through the Interior Valley, to indicate with precision the ratios of difference. I will proceed to state the few which have been made by myself, or published by others, beginning in the south.

1. Near Mobile Bay, in north latitude 30° 42′, I found the temperature of the Thundering Spring*, and that of another almost as copious, to be respectively, 69° and 68°—giving the mean, 68° .5, to which half a degree must be added to make it equal to the year, 69°. Now from three years observations, Doctor North got 70°.3, as the mean annual heat of Mobile. Thus, the temperature of the air at that place, near the thirty-first parallel, is 1°.3 higher than that of the earth.

2. A most copious perennial spring, at Tuscumbia, Alabama,† had a temperature of 60°, in the latter part of the month of June. As at that period of the year, the mean heat of such a spring is the same as for the year, no correction is required. I do not know the mean temperature of the air at Tuscumbia; but that of Huntsville, a short distance to the east, in north latitude 34° 45′, according to observations, through thirteen years, by the Rev. Mr. Allan, is 59°.73, or less than one-third of a degree below the heat of the spring — suggesting equality, at the thirty-fifth parallel of latitude.

3. At Hudson, south of Lake Erie, in the State of Ohio, in north latitude 41° 15′, Professor Loomis ‡ made three years' observations on the temperature of two wells, one a little below, and the other as far above, fifty feet in depth. For a part of the time, they were made nearly every other month—for the remainder, in the months which he found to present the extremes. I have condensed the means of the whole, into the following table.

MONTHS.	MEAN TEMP.	ABOVE.	BELOW.	RESULTS AND COMPARISONS.
	°	°	°	
JANUARY, ...	48.25	——	1.00	Range from Jan. to August, 1.82
FEBRUARY,..	48.47	——	0.78	
MARCH,.......	49.12	——	0.13	Mean heat of wells, 49.25
JUNE,..........	49.30	0.05	——	Mean heat of air, 47.40
AUGUST,......	50.07	0.82	——	
SEPTEMBER,.	50.07	0.82	——	Excess of earth's temperature, 1.85
NOVEMBER,..	49.50	0.25	——	

It appears from this table, that in advancing north from 34° 45′, to latitude 41° 15′, the heat of the earth rises over that of the air 1° .85, or nearly (.3) three tenths of a degree for one of latitude.

4. Cold Spring, at Castalia, near Sandusky City, within a few minutes of the latitude of Hudson, but at a level five hundred feet lower, had,

* P. 56. † P. 223. ‡ Silliman's Journal, Vol. 41.

in the month of August, a temperature of 52°. Correcting it, by subtracting .82, according to the above table, its annual heat is 51°.18, from which, according to the same table, 1°.85 must be deducted for the excess of the heat of the earth, leaving, for the mean temperature of the air, 49°.33, or 1°.90 more than that of Hudson; but when we deduct from it, 2°, for the difference of altitude, we have 47°.33, a number nearly identical with that of Hudson; and well-fitted to show that a permanent spring, with a large volume of water, may, by the proper corrections, be made to indicate the mean temperature of the air.

5. At Oneida Conference Academy, New York, in north latitude 42° 55′, observations were made, in each month, through three successive years, on the temperature of a well. I have condensed the whole into the following table, where the annual temperature is compared with that of the air, from observations continued for seventeen years.*

MONTHS.	MEAN TEMP.	ABOVE THE YEAR.	BELOW THE YEAR.	REMARKS AND COMPARISONS.
	°	°	°	
JANUARY,...	46.33	——	1.12	
FEBRUARY,..	45.50	——	1.95	
MARCH,.......	46.50	——	.95	
APRIL,........	46.94	——	.51	Temperature of April obviously too high — that of March, too low.
MAY, ...	46.11	——	1.34	
JUNE, ...	46.61	——	.84	
JULY,..........	47.40	——	.05	
AUGUST, ...	48.33	.88	——	Range from Feb. to Sep., 4°.60
SEPTEMBER,	50.10	2.65	——	Mean temperature of well, 47°.45
OCTOBER,....	50.00	2.55	——	Mean temperature of air, 43°.58
NOVEMBER,..	48.25	.80	——	
DECEMBER,..	46.83	——	.62	Excess of well over air, 3°.83

At this place, we find the mean heat of the earth to be 3°.83, or 2° more than at Hudson, while it lies only 1° 40′ further north; showing a ratio of increase of the difference between terrestrial and atmospheric mean heat, of 2° .3 for a degree of latitude. When, however, we compare this station with Huntsville, where we have placed our zero, 8° of latitude further south, we find the ratio of increase of terrestrial over atmospheric mean heat, to be only .48, or less than half a degree, for every degree of latitude.

6. At Rochester, north latitude 43° 07′, the Reverend Mr. Dewey† ascertained the temperature of an artesian well, two hundred feet deep, to be 50°, the observations being made in July and December. From this, we must deduct 2°, for the increase of heat below the plane of invariable temperature, leaving 48° as the heat above that place. Now the mean atmospheric heat of Rochester, from two long series of observations, is 46°.42.

* Regent's Reports University of New York. † Ibid.

which, deducted from 48°, gives only 1°.58 for the excess of the fountain over the atmosphere, which is even less than that of Oneida. If we divide this by the difference in latitude, nearly 8°, between Huntsville and Rochester, we have (.2) two-tenths of a degree for the ratio of increase of divergence, between the terrestrial and atmospheric curves.

7. From six years' observations, the mean temperature of the Island of Mackinac, north latitude 45° 51′, is 40°. In a recess of the eastern escarpment of the Island, two hundred feet below its summit, a permanent spring bursts out from the limestone strata, the temperature of which, I found, at the end of July, to be 44°, which may be received as its annual mean. This is 4° above the atmospheric mean, and 2°.18 more than the difference at Hudson, 4° 36′ further south. These numbers give a ratio of (.48) forty-eight hundredths, for a degree of latitude; but when we divide the 4° by the difference of latitude, 11°, between Huntsville and Mackinac, we obtain the ratio (.36) thirty-six hundredths.

The mean of all the ratios, counting from Huntsville, as zero, is .33, or one-third of a degree. Thus, in advancing north from the thirty-fifth to the forty-sixth parallel, every three degrees of latitude add one degree to the range of the mean heat of the earth over that of the air; and as three degrees of latitude sink the mean temperature five degrees, it follows, that a change to that amount will indicate a change of one degree in the relative temperatures of the earth and air.

I am far from regarding this as a reliable conclusion; but hope that what has been said, may incite those who are favorably situated, to more careful and accurate observations than have yet been made. All the stations which have been named, except one, lie within a few degrees of longitude of each other. I must now say something of one, lying six degrees west of the most western of those stations.

8. Fort Snelling, situated in north latitude 44° 53′, has a mean temperature, deduced from eighteen years' observations, of 45°.15. The temperature of a spring, in Carver's Cave, a few miles from the Fort, was found by Mr. Schoolcraft, on the 2d of August, to be 47°. On the 16th of July, in a subsequent year, Major Long found it 46°.* The months were such, that no correction is necessary. If we take the mean of these observations, 46°.5, as the heat of the earth, and deduct from it that of the air, the difference is only 1°.35, which divided by the number of degrees of latitude between the Cave and Huntsville, gives a ratio of (.135) one hundred and thirty-five thousandths.

This low ratio suggests an inquiry into the influence of local causes. To the north of Carver's Cave, is the table land between the sources of the Mississippi and Lake Superior, the elevation of which is about seven hundred feet above the Cave. From this plateau the strata dip to the south, and it seems probable, that the spring consists of water conducted down from that higher level and more northern latitude, which must of necessity

* Second Expedition.

reduce its temperature below that of the earth, where it bursts out. That a spring may have its source so distant from the place where it is inspected, as to give a different temperature from that of the spot, cannot be doubted; and this must be taken into account. There are other circumstances, moreover, which must not be overlooked.

If the spring or well be near the surface, and the quantity of water variable or not very great, much more frequent observations are necessary, than under opposite circumstances. If the well should be broad and its depth small, the sudden changes of atmospheric heat will perpetually vary that of the surface of the water. Again, cold rains, and the melting in spring of great snows, may be the means of cooling superficial wells and springs. If these sources of error should be disregarded, inaccurate results will of course be obtained.

X. Influence of the Northern Lakes on Mean Temperature.—The Northern Lakes of the St. Lawrence Basin, do not appear to exert any influence on the mean temperature of the air. If we compare Bloomington, Prairie du Chien, Winnebago, and Fort Snelling, all in the interior, with Fredonia, Rochester, Fort Gratiot, Mackinac, and Fort Brady, lying among the Lakes, and make due allowance for differences of latitude and elevation, we find, that the higher mean temperatures sometimes belong to one class of stations, and sometimes, to the other, while the average difference of the whole, is less than a quarter of a degree.

XI. Variation in the Mean Annual Heat of the same Places in different Years. — This, for a considerable number of places, has been presented in the General Table of Mean Temperatures, from which the following selections have been made. The numbers of the first column belong to that table, and will direct the attention of the reader to the position of the stations embraced in this. Here, as there, they are arranged from south to north. To fit these results for comparison with each other, the observations at every station should have been continued for the same number of years. As it is, most of them afford but a distant approximation to the truth.

GREATEST VARIATION IN THE ANNUAL MEAN HEAT OF THE SAME PLACES IN A SERIES OF YEARS.

No.	Place.	Range.	Years.	No.	Place.	Range.	Years.
		°				°	
7	Ubajoy,	3.80	4	44	Springville,	5.90	8
8	Key West,	1.62	6	45	Prattsburg,	11.14	6
9	Tampa Bay,	1.82	5	46	Cayuga,	3.00	9
14	Thirtieth Deg. of Lat.	3.43	11	47	Middlebury,	7.49	15
15	Pensacola,	4.34	6	48	Canandaigua,	5.18	8
19	Fort Jesup,	3.72	7	50	Pompey,	7.31	13
20	Natchez,	3.80	10	51	Onondaga,	6.88	12
23	Huntsville,	3.74	13	55	Rochester,	5.56	15
26	Nashville,	3.38	5	56	Lewiston,	6.20	11
27	Louisville,	5.00	6	57	Mexico, N. Y.,	3.91	8
30	St. Louis,	5.81	16	59	Lowville,	7.23	16
31	Portsmouth,	5.97	20	61	Pottsdam,	5.44	18
32	Cincinnati,	5.47	21	62	Fort Howard,	4.32	9
34	Marietta,	5.59	26	64	Fort Snelling,	5.69	8
35	Steubenville,	6.33	12	65	Montreal,	7.37	15
37	Bloomington,	11.20	9	67	Fort Brady,	3.86	6
43	Fredonia,	6.68	14				

1. A glance of the eye upon this table discloses that, as we advance from south to north, the difference between the coldest and hottest years increases; that is, as the annual mean temperature lessens, the range of libration in different years increases. I have sought to ascertain the law which governs these inversely-varying quantities. By averaging the mean temperature of twenty stations, varying from 70° to 40°.5, a mean temperature of 52° is obtained. At these stations, observations had been made through periods varying from nine to twenty-six years, and the mean libration is 6°.16. Now it is well known, that in the equatorial regions, the mean temperature of which is 82°, the difference between one year and another, at the same place, is so little that we have there the zero of libration. The amount, 6°.16, then, is the result of the difference between 82° and 52°=30°. But if we divide 6°.16 by 30°, we obtain 0°.205 (two hundred and five thousandths) of a degree of temperature of libration, for every degree of mean annual temperature lost. Rejecting the fraction (five thousandths), we have a ratio of (0°.2) two-tenths of increasing heat, of libration, for one degree of decreasing mean annual heat; and, conversely, five degrees of the latter originating one degree of the former. The application of this law is abundantly simple. The mean annual heat of the place must be subtracted from 82°, and the difference multiplied by (.2) two-tenths — the product is the range of libration, or difference between the coldest and hottest years at that place. For example: The difference between the mean temperature of Portsmouth, and the equatorial mean, 82°, is 26°.64, which being multiplied by .2 (two-tenths) gives 5°.33, which is but .64 (less than two-

thirds) of a degree, different from the range between the coldest and hottest year, as ascertained by observations continued for twenty years. Again: The mean annual temperature of Montreal, is 37°.43 below 82°, which multiplied by .2, gives 7°.49 as the range of annual libration, which, observations continued through fifteen years, have placed at 7°.37, only an eighth part of a degree less. In all cases, the results of calculation do not so closely coincide with those of observation, but generally vary less than a degree; although at many places, the observations have not been continued long enough, to complete the cycle of yearly variation. By the formula which has been obtained, if the annual heat of the year were settled by an observation made in June or December, on a well, eighty or one hundred feet deep, or a copious and permanent spring, issuing from beneath a hill, it would be possible, at once, to determine, with (approximative) certainty, the temperature of the hottest and coldest years that would ever occur there.*

2. By the formula deduced from the table, we are enabled to investigate the influence of large bodies of water, as the Northern Lakes, on the librations of annual temperature. In calculating the range for all the stations around those Lakes, it is found, I believe, with one exception, to be greater than that afforded by observation. Thus, the average of eight stations, is, by observation, 4°.81, for the range of libration, but from calculation it should be 7°.24, or more than 50 per cent. greater. The exception to which I have referred, is presented by Fredonia, where the range from calculation is equal to that from observation; but this only confirms the rule; as a shelf of the Appalachian Mountains, seven hundred feet higher than that place, terminates by a bold escarpment, within a few miles of Lake Erie, and it lies between them; thus the influence of the Lake is neutralized by that of the mountains. No other station, around the Lakes, bears the same relation to mountains. Thus the restraining influence of the Lakes is clearly established. They do not modify the mean annual temperature, but limit its extreme range in different years.

XII. Isothermal Curves. — The curves of equal mean temperature, which traverse the Interior Valley, cannot yet be delineated, from the want of a sufficient number of observations. In the West, from the cooling influence of the Cordilleras of Mexico, and the Rocky Mountains, extending into

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* It will be seen that Bloomington, Iowa, and Prattsburg, New York, present ranges between the hottest and coldest years, that are quite anomalous. I suspect that in both cases there is a mistake. The cold year, 1847, in the Bloomington observations, was 4°.80 below the average mean heat of that place; but at St. Louis, only 2° 49′ further south, in the same longitude, that year fell only °.66 below the mean temperature of sixteen years; and at Marietta, two degrees farther south, but ten degrees farther east, the mean heat of the same year fell only °.81 below that of its general mean temperature. In the case of Prattsburg, the extraordinary year, 1839, fell 7° *below* the general mean of that place, but the mean heat of the same year at Springville, was 1°.39 *above* the average yearly heat of that place, although they lie nearly in the same latitude, and only 1° 30′ of longitude apart. It seems quite impossible, that places so contiguous should, in the same year, have temperatures varying so widely from their respective mean temperatures.

the polar circle, and to the East, from a similar though smaller influence, of the same kind, exerted by the Appalachian chain, from the latitude of 33° to 48° or 50° north, we know that the curves of equal mean temperature, cannot lie parallel to the lines of latitude, except for a certain distance in the middle of the Valley. East of the Mississippi, as they approach the Appalachian Mountains, they must bend to the south; west of that river, as they ascend the great inclined plane, they must curve in the same direction; and on reaching the Rocky Mountains, must of necessity, extend along their slopes, rising gradually, as the latitude lessens; but not attaining the summits of those mountains, until we come within the tropics. It results from these data, that the isothermal lines of the Valley, are nearly parallel to those of one side of a compressed ellipsis or long oval, with their eastern curved extremities much shorter than their western. Where they intersect the trough of the Mississippi, they have their highest latitude. Thus, the curve of 67°, descending from the Cordilleras, near Xalapa, in north latitude 19° 30′, passes near Natchez, on the Mississippi, 12° further north, that number being equivalent to four thousand feet of difference in their elevation. From Natchez, it probably continues eastwardly on the same parallel of latitude. The curve of 62°, traversing the City of Mexico in latitude 19° 26′, enters the State of Arkansas, about the latitude of 33° 30′, after passing near Fort Towson, cuts the Mississippi 14° north of Mexico, crosses the State of Alabama, a little south of Huntsville, and ascending the mountains of Georgia, turns again to the south. But this configuration is true of that portion of the Valley only, which is bounded on the east by the Appalachian Mountains. South of those mountains, below the latitude of 33° north, the eastern extremities of the curves of temperature, do not bend to the south, as the surface rises but little above that of the Gulf and the delta of the Mississippi; but the western ends of the curves still bend to the south as they ascend the mountains of Mexico. Above the latitude of 48° north, a different configuration occurs. As the curves descend from the Rocky Mountains, they rise rapidly to the north, until they approach the meridians of the Pole of maximum Cold, when, independently of elevation, they are deflected to the south, again (it is probable) to ascend, on approaching the eastern edge of the Continent. Thus, the isothermal curve of 17°, which passes Fort Franklin in north latitude 65°, and west longitude 123°, after having advanced rapidly to the north on descending from the mountains, is bent to the south, and by the time it reaches the 80th degree of longitude, must, according to the temperature of Winter Island, have sunk as low as the 58th degree of latitude; afterward to ascend, on advancing to Davis' Straits. In traversing the Valley, then, this curve is serpentine, presenting in the western part a vertex to the north—in its eastern, a vertex to the south; in the latter of which we find the southern limit of the Pole of Cold.

XIII. Alleged greater Heat of the Middle Latitudes of the Interior Valley, than of the Atlantic Plain.—In 1783, Mr. Jefferson published, that the Basin of the Ohio was warmer, by the amount of three degrees of latitude, than the maritime belt east of the mountains*; and about twenty years afterward, M. Volney,† on returning from his travels through this country, adopted the same conclusion. In 1815, I endeavored to show,‡ that the opinion to which those distinguished writers had given currency was erroneous. At that time, the number of reliable observations was small, compared with the present; yet the error into which Mr. Jefferson had fallen, by a premature generalization, was correctly pointed out; as numerous observations on both sides of the mountains, have since shown. As it is not in the plan of this work to institute comparisons between the climate and diseases of the Interior Valley, and the regions beyond the mountains, which bound it to the east and west, I shall limit myself to the assertion which has been made, leaving it with others, to compare the observations, which show that in the same latitudes the temperature of the climates on the opposite sides of the Appalachian range, is substantially the same. The physician, then, of Maryland or Pennsylvania, who would advise his patient to emigrate to a milder climate, must not point out the State of Ohio; nor must the invalid of Virginia, expect a warmer climate by removing to Kentucky. Much of the popular perpetuation of this error, has come from the direction of the great current of immigration into the middle latitudes of the Mexican, and the southern portion of the St. Lawrence Basin. It has been largely from higher to lower latitudes, and yet it was all, in the phraseology of the people and the profession, to the West. They reached a warmer climate, by going south, and without investigation pronounced it the consequence of traveling westwardly.

XIV. No Change of Mean Temperature resulting from the Settlement of the Valley.—Whatever may be the influence of the settlement and cultivation of a new country, on its mean temperature, the Interior Valley has not undergone such a degree of transformation, as might produce an appreciable effect. An immense proportion of it, is in the same condition as when the French first ascended the estuary of the St. Lawrence, or encamped among the swamps of the Mississippi. The greatest changes of surface, have been effected on the eastern side of the Mississippi, between the Tennessee River and the Lakes; and in that region, if anywhere, a change of mean temperature has taken place. There are no facts, however, which indicate such a change. At the beginning of the present century, the population of the region mentioned was exceedingly sparse, and no thermometrical observations were recorded, to show the mean temperature of any spot, while the country was still a wilderness. The earliest series of observations were made, in the neighborhood of Cincinnati, by Colonel Jared Mansfield, Surveyor General of the United States. They were begun in 1806, and continued for three years. The results, in connection with observations by myself, in Cincinnati, for the next five years,

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* Notes on Virginia. † View of the Soil and Climate of the U. S.

‡ Picture of Cincinnati, by Daniel Drake. 1815.

were published, in 1815.* The mean deduced from the whole, was 54°.25. The mean resulting from observations by Professor Ray, from 1835 to 1847, is 53°.36, giving a difference of less than nine-tenths of a degree — altogether within the limits of inaccurate observation and incorrect instruments. From the middle term of one of these periods to that of the other, is about one-third of a century; but that time has effected no change, although the increase of the population and the consequent destruction of the forest, have been at a high ratio.

SECTION II.

EXTREMES OF COLD AND HEAT.

I. The Table. — An inquiry into the lowest and highest degrees of heat, at a place through the whole period of time in which observations are made, naturally follows on the study of the coldest and hottest years. The data for this inquiry are presented in the following table. The *first* column is for reference to the General Table of Mean Temperatures, where the position of each place can be found; the *second* presents the mean temperature of each; the *third* gives the amount of range; the *fourth*, the *percentage* of range above or below mean temperature; the *fifth*, the greatest cold; the *sixth*, the greatest heat; the *seventh*, the distance of the former below mean temperature; the *eighth*, the distance above mean temperature; the *ninth*, the percentage of the fall over the rise; the *tenth*, the number of years of observation. Those, it will be observed, vary widely from each other, for which great allowance must be made, in estimating the relative ranges of different places. Thus, if observations have been continued twenty years in one place, and only five in another, where the ranges in the long run are equal, the probability is four times as great, that both the extremes that can ever occur, will be included in the former period than in the latter. It is obviously impossible to know the length of time between the lowest and highest degree of heat at any place. The greatest extremes which could possibly occur, might be within a few years of each other, or even happen in the same year; and on the other hand, centuries might elapse, before each would be witnessed. It seems to me probable, that as the wood-land portions of the Valley become denuded of forest, the extremes will become greater. Both the hot and the cold winds will then have a more rapid sweep, and the sun, in summer, an increased power on the stratum of atmosphere which rests upon the earth.

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* Picture of Cincinnati.

TABLE OF THE EXTREMES OF ANNUAL TEMPERATURE: MINIMA AND MAXIMA.

No. referring to Gen. Tab.	PLACES.	Mean Temperature.	Range.	Per cent. on Mean Temperature.	Minima.	Maxima.	Dist. from Mean Temp. to Min.	Dist. from Mean Temp. to Maxi.	Per ct. of down. on upward range.
		°	°	°	°	°	°	°	°
2	Cumana, - - - -	81.5	——	——	——	92	——	12.8	——
3	Vera Cruz, - - - -	77.0	——	——	——	90	——	13.4	——
6	Havana, - - - -	77.0	36	——	+59	94	18.0	17.4	5.8
7	Ubajoy, - - - -	73.5	——	——	+32	——	41.5	——	——
8	Key West, - - -	76.5	40	——	+50	90	26.5	13.5	96.3
9	Fort Brooke, - -	72.4	74	3.0	+20	94	52.4	22.4	142.6
10	Fort King, - - -	71.6	95	32.8	+11	106	60.6	34.4	95.9
14	30th Parallel, - -	70.1	86	22.4	+14	100	56.1	29.9	87.8
15	Pensacola, - - -	68.4	92	34.5	+ 6	98	62.4	29.6	108.0
17	Baton Rouge, - -	67.5	90	33.3	+10	100	57.5	32.5	77.4
18	Mobile, - - - -	70.3	70	00.0	+24	94	46.3	23.7	95.0
20	Natchez, - - - -	66.8	97	45.2	0	97	66.8	30.2	121.8
22	Fort Towson, - -	61.2	103	69.9	— 3	100	64.2	38.8	65.2
23	Huntsville, - - -	59.7	105	75.8	— 9	96	68.7	36.3	89.5
25	Fort Gibson, - -	61.1	123	101.3	— 7	116	68.1	54.9	23.9
26	Nashville, - - -	58.4	118	100.0	—18	99	76.4	40.6	88.6
27	Louisville, - - -	55.0	110	100.0	—10	100	65.0	45.0	44.4
29	Jefferson Barracks,	56.9	119	109.1	—18	101	66.9	43.1	70.0
30	St. Louis, - - -	55.3	134	142.3	—25	109	80.3	53.7	49.8
31	Portsmouth, - -	55.3	106	91.6	— 6	100	61.3	44.7	37.4
32	Cincinnati, - - -	53.8	117	119.3	—18	100	70.8	46.2	53.2
33	Fort Leavenworth,	52.3	135	158.1	—30	105	82.3	52.7	56.4
34	Marietta, - - -	52.8	117	121.5	—18	99	70.8	46.2	53.3
36	Steubenville, - -	50.8	107	90.9	—12	95	62.8	44.2	42.2
38	Bloomington, - -	50.0	123	146.0	—25	98	75.0	48.0	56.2
39	Council Bluffs, - -	51.1	129	157.0	—21	108	71.1	57.9	26.6
40	Fort Armstrong, -	50.6	122	141.1	—24	98	74.6	47.4	57.6
41	Fort Dearborn, - -	46.1	114	147.3	—22	92	68.1	45.9	48.1
42	Cuba, N. Y., - -	41.4	118	185.0	—26	92	67.4	50.6	37.3
43	Detroit Barracks, -	46.9	99	111.0	— 5	94	51.9	47.1	10.4
44	Fredonia, - - -	48.8	104	113.1	— 8	96	56.8	47.2	20.5
45	Springville, - - -	44.8	107	138.8	—14	93	58.8	48.2	22.2
46	Prattsburg, - - -	42.8	119	178.0	—19	100	61.8	57.2	25.6
47	Cayuga, - - -	48.7	106	117.6	—10	96	58.7	47.3	24.0
48	Middlebury, - - -	46.6	119	155.3	—17	102	63.6	55.4	14.7
49	Canandaigua, - -	46.0	96	108.7	— 8	88	54.0	42.0	28.6
50	Fort Gratiot, - -	46.8	127	171.3	—18	109	64.8	62.2	4.2
51	Pompey, - - -	42.8	119	178.0	—26	93	68.8	50.2	36.0
52	Onondaga, - - -	47.1	113	140.0	—14	99	61.1	51.9	45.8
54	Fort Crawford, - -	47.3	132	179.0	—32	100	79.3	52.7	50.7
56	Rochester, - - -	46.4	108	132.7	— 6	102	52.4	55.6	——
57	Lewiston, - - -	48.0	102	112.5	— 6	96	54.0	48.0	12.5
58	Mexico, N. Y., - -	44.1	120	172.1	—24	96	68.1	51.9	3.1
59	Fort Winnebago, -	44.9	132	194.0	—33	99	77.9	54.1	43.9

EXTREMES OF ANNUAL TEMPERATURE — CONTINUED.

No. referring to Gen. Tab.	PLACES.	Mean Temperature.	Range.	Per cent. on Mean Temperature.	Minima.	Maxima.	Dist. from Mean Temp. to Min.	Dist. from Mean Temp. to Maxi.	Per ct. of down. on upward range.
		°	°	°	°	°	°	°	°
60	Lowville. - - -	43.7	131	200	—35	96	78.7	52.3	50.5
61	Madison Barracks,-	46.5	106	128	—16	90	62.5	43.5	43.9
62	Potsdam. - - -	43.5	122	180	—28	94	71.5	50.5	41.4
63	Fort Howard, - -	44.6	132	196	—32	100	76.6	55.4	38.3
64	Penetanguishine, -	45.1	122	170	—32	90	77.1	44.9	36.1
65	Fort Snelling, - -	45.1	140	210	—40	100	85.1	54.9	52.2
66	Montreal. - - -	44.6	126	180	—28	98	72.6	53.4	35.8
67	Mackinac, - - -	40.0	113	182	—23	90	63.0	50.0	26.0
68	Fort Brady,- - -	40.6	131	223	—33	98	73.6	57.4	28.3
70	Cumberland House,	32.0	131	309	—44	87	76.0	55.0	38.2
72	Chipewyan, - - -	29.2	141	329	—44	97	73.2	67.8	26.6
75	Fort Reliance, - -	21.5	——	——	—70	—	——	——	——
76	Enterprise, - - -	14.2	135	850	—57	78	71.2	63.8	11.6
77	Fort Franklin, - -	17.2	133	673	—53	80	70.2	62.8	1.2
78	Winter Island, - -	6.8	96	1311	—42	54	48.8	47.2	3.6
79	Igloolik, - - - -	2.5	100	3900	—50	50	52.5	47.5	10.5
80	Felix Harbor, - -	3.6	117	3150	—47	70	50.6	66.4	——
81	Fort Bowen, - -	3.6	97	2594	—47	50	50.6	46.4	2.7
82	Melville Island. -	—1.07	115	11607	—55	60	53.9	61.1	——

II. RELATION OF RANGE TO MEAN TEMPERATURE.—The intertropical observations, are too few, to disclose the relation between the extremes and the mean annual heat; but they show that the latter is vastly greater than the former. This continues to be the case at Key West, in N. Lat. 24° 34′; but ceases at Tampa Bay, in Lat. 27° 57′, where they are equal, and the mean heat is 72°.40. If we may rely on a single observation, we may conclude, that in advancing to the north, from the equatorial regions, the range is less than the mean temperature, until the latter has sunk 10°. The Gulf of Mexico no doubt augments the influence of a low latitude, in restraining the extremes of cold and heat, for Ubajoy, an interior station, near Havana, evidently suffers a much wider range than that city; and Fort King, only fifty or sixty miles from the Gulf, with a mean temperature less than one degree lower, exhibited in three years a range 21° greater than Tampa suffered in nine. The range of Pensacola is 92°, which may be regarded as that of the northern coast of the Gulf of Mexico, in the mean temperature of 69°. From this base line we start into the interior of the continent, and up to the 48th parallel, that is, through 18° of latitude, which reduce the mean heat from 69° or 70° to 40° or 41°, we have a tolerable supply of reliable observations. In running the eye over this section of the table, we find that the range, with a few exceptions, is above 100° — at one station up to 140°. But the ranges are in no regular relation to the mean annual temperatures. For example, the range at Fort

Gibson and Cincinnati is the same, although the mean temperature of the former is 7° the greater; the ranges for Nashville and Marietta are identical, although their mean temperatures vary nearly 6°; and the range at St. Louis is 11° greater than at Bloomington, while the mean annual heat of the latter is 6° less. When we advance beyond the forty-eighth parallel, in the line of stations which are found between Hudson Bay and the Rocky Mountains, we observe the same anomalies; but at most of them the range is that which a single year presented. The highest among them, at Chipewyan, is 141°, but a degree above that of Fort Snelling, although their mean temperatures differ 14°; and two other stations, Fort Enterprise and Fort Franklin, with mean temperatures of 14° and 17°, have ranges of 133° and 135°, identical with those of St. Louis and Fort Leavenworth, whose mean temperatures are, respectively, 38° less. For a further apprehension of this matter, the reader may consult that column of the table, in which the relations of the range to the mean heat of each place is expressed *per centum.* The conclusion to which we are led is, that after advancing into the continent, beyond the influence of the Gulf, and keeping at a sufficient distance from the Lakes and Hudson Bay, the extremes of heat and cold have no fixed relation to the annual temperature, and are nearly or quite as great in the middle as in the northern latitudes of the Valley. But although they do not increase with the increase of latitude, and the consequent decrease of mean temperature, they are not a fixed quantity; but vary among themselves, where the latitudes and conditions of the surface would lead us to expect uniformity. It thus appears, that intense degrees of cold and heat may be transiently produced within very limited spaces, by local atmospheric influences, which are not well understood.

III. INFLUENCE OF THE MOUNTAINS ON THE RANGE OF TEMPERATURE.—Eight of the western stations of the Valley, those nearest to the Rocky Mountains, present an average of 122° for the range; an equal number of stations, all lying considerably east of the Mississippi, and running through the same latitudes, give an average of 114°, showing the western ranges to be seven *per centum* greater than the eastern. This result is less than I expected; and the general impression is, that as we advance toward the Rocky Mountains, from the Basin of the Ohio River, the extremes become greater, at a ratio much higher than is indicated by the difference here presented. I can only reconcile popular opinion with the results of scientific observation, by referring to the impetuous winds which sweep over the great grassy plain, and reduce the temperature of the living body, and all moist surfaces, by promoting evaporation, while their own temperature, only, is indicated by the dry thermometer. In this way, the tributaries of the Missouri may be covered with thicker ice than those of the Ohio, by the same *thermometrical* depression of temperature. A prevailing opinion is, that the immediate contiguity of mountains generates violent extremes of temperature; but when we compare Huntsville, Nashville, and Steubenville, all lying near to spurs of the Appalachian Chain, which rise from one thousand two hundred to one thousand five hundred feet above them, with

Louisville and Cincinnati, which are much more remote, we find the average range at the two latter places 3° greater than at the three former. But this result does not, perhaps, overthrow the general opinion, for those stations lie on the windward side of the mountain chain, which, therefore, but seldom rolls back its currents of air upon them.

IV. INFLUENCE OF THE NORTHERN LAKES ON THE EXTREME RANGE.—Ten stations, on or near the shores, bays, and connecting straits of the Lakes, give an average range 14° degrees less than an equal number of inland stations, lying east and west of them. This difference of about thirteen *per centum*, shows a restraining influence on the extreme range; but it is not exerted at all stations, for the five highest of the lake series are, in the aggregate, equal to the five lowest of the inland series. These lake-stations are Howard, Brady, Gratiot, Penetanguishine, and Mexico, the relation of which to the lakes may be seen on the general hydrographical map (*Pl. I*); the remaining five stations are Mackinac, Fredonia, Lewiston, Rochester, and Sackett's Harbor, the average of which is 22°, or twenty *per centum* below the average of the inland posts. Mackinac is an island, and the four other stations lie on the southern coast of Erie and Ontario. It is, then, on those coasts that the restraining lacustrine influence is chiefly felt. It is, moreover, not limited to the lake margins, but extends for many miles from them. Thus, the average of Springville, Canandaigua, Middlebury, Cayuga, and Onondaga, is 21°, or sixteen *per centum* below the average of the more inland stations, employed in this comparison. The whole of these places lie east of Lake Erie, and south of Lake Ontario, and are, therefore, to the winter leeward of those lakes, as well as Michigan, Huron, and Superior. As the summer winds do not blow over the other towns on the south sides of Erie and Huron, those lakes cannot, of course, restrain the range of temperature by lowering the maximum, but by keeping up the minimum.

V. INFLUENCE OF HUDSON BAY AND THE POLAR SEA ON THE RANGE OF TEMPERATURE.—Meteorological observations have been made at one place only, on the shores of Hudson Bay, and I have not even seen a statement of the lowest and highest degree of heat at that station. In the maritime region to its north, observations have been made on three islands and two cape-coasts. The highest of the whole is but 117°—the average, 105°. Compared with the average of Fort Enterprise and Fort Franklin, the most northern inland stations to the west, the marine influence is decided; the difference between the two groups of stations, being 29°, or twenty-eight *per centum*. The group we are now investigating lies within the limits of the Pole of Cold.

VI. RELATION OF THE MINIMA AND MAXIMA, OR OPPOSITE EXTREMES OF TEMPERATURE, TO THE MEAN ANNUAL HEAT.—If we add the difference between mean temperature and the lowest degree of heat, to the difference between mean temperature and the highest, at each place, as set down in the foregoing table, and divide their sum by two, we find the quotient, with a few slight exceptions, to be less than the annual mean heat. Thus it is a law of our climate, that the range of temperature depends more on depression below, than elevation above mean heat. The reverse of this, I suppose, is the popular opinion. The proportion in which the minima and maxima of heat vary from the mean temperatures, is set down *per centum*, in the last column of the table, the numbers of which express the per centage of the greater or downward departure, from the less or upward. The most cursory inspection of this column of the table, shows that the variation among different places is considerable. A full development of the causes of these variations, is not perhaps attainable; but an extended examination discloses that there are three regions where the differences between the upward and downward ranges are much reduced, in a few cases to equality, and in three or four, beyond that point; so that the rise exceeds a little the fall from mean temperature. The regions in which this comparative reduction of the downward arm of the range is found, are the shores of the Gulf of Mexico, the Northern Lakes, and the Polar Sea. It does not, then, depend on variations — the annual temperature of different places has, in fact, no connection with it; but results from the influence of adjacent bodies of water, which, in winter, whether in the north or south, enjoy a higher temperature than the continent. On the other hand, the vicinity of the Rocky or Appalachian Mountains, may, in places lying to their leeward, exert, in winter, a cooling influence, and thus augment the downward range. Hence we find that the causes which diminish the length of that part of the range, are precisely those which diminish the length of the whole range, as pointed out in the preceding number — V. It may be assumed, however, that deep waters and high mountains reduce the upward range, as well as the downward, and this is probably the case; but to a less extent. In examining the maxima of places on the shores of the Gulf, we find them less than in the interior, further north, and may therefore conclude that they are kept in check, by the extensive oceanic surface to their windward; and that if it were converted into a continental plain, the extreme heat of Vera Cruz, Key West, and other places around the Gulf, would be augmented. When we advance, northwardly, to the Lakes, we find that all their southern and western shores, are swept over by winds from the south-west, which keep up a high maximum; while their breadth is so limited, that the hot currents of air reach their northern coasts, without suffering much reduction of temperature; hence the maxima of heat, on those coasts, is actually greater than on those of the Gulf. Thus the Lakes and the Gulf, restrain the range of temperature in different ways; the former by diminishing the downward range, the latter by diminishing the upward: one acts as a warmer in winter, the other as a cooler in summer. We are now prepared to understand how it is, that Rochester presents the anomaly, the only one from Key West to Winter Island through 42° of latitude, of having the lower portion of its range nearly six *per centum* less than the upward, while at every other station, within the latitude mentioned, it is greater. The winds which reach it in summer, have traversed the vast plain to its south-west, and become greatly heated; those which pass over it in winter have swept across the lakes from the western extremity of Lake Superior, and have had their temperature increased; if they were replaced by land, the descent of the thermometer would not be arrested at —6°, as it now is. The southern shore of Lake Ontario presents another anomaly, which requires to be noticed. Mexico, but 20′ north of Rochester, and still nearer to the lake, presents a maximum only 6° below that town, but a minimum four times as great; that is, —24°. This again can be explained. Mexico lies at the narrow, eastern extremity of Lake Ontario, the axis of which is from south-west to north-east, and therefore the north winds reach it without traversing the Lakes. Thus, in estimating the influence of large bodies of water, on the places which surround them, reference must be had to the course of the cold and hot winds.

Advancing to the Polar Sea, we find five insular or littoral stations, on three of which the descending range is a few degrees greater than the ascending; and two other stations, in which the reverse occurs, the range above mean temperature being greater than below. Thus, within the Polar Circle, over the Pole of Cold, at the margin of a sea, whose ices never melt, the same approach to equality is found, between the downward and upward variations from mean temperature, as exist at Key West and Havana, where the tropic cuts the Gulf of Mexico. In the former region, two causes seem operative in restraining the descent of the thermometer, and consequently reducing the minimum to nearly the same degree with the maximum. The first is the temperature of the sea, which cannot be sunk below the freezing point, though the ice which covers it may; the second is, that no colder region exists, to pour over it a wind of lower temperature, than belongs to its own fitful and chopping gales. In evidence of this, we may refer to Fort Reliance, in the direction of the Rocky Mountains, which, with a mean temperature of 21°, has a depression of —70°, or 15° more than that of Melville Island, whose mean heat is —1°.07. In winter, the air from the summits of the Rocky Mountains, within the Polar Circle, descends upon Reliance, which, at the same time, is surrounded by land instead of water.

VII. Continental Extremes.—It may not be uninteresting to bring together some of the most striking examples of high and low temperature, which have been observed in the Continental Valley. Of the former, I will take those only which are above 100°; of the latter, such as stand below the freezing point of mercury. The numbers in each column are placed in the order of increasing amount. They are *artificially* paired off, so as to form a column of ranges, which is placed between the other two:

EXTREMES OF TEMPERATURE.

PLACES.	HIGH.	RANGE.	LOW.	PLACES.
	°	°	°	
Jefferson Barracks,	101	143	—42	Winter Island.
Middlebury,	102	149	—47	Felix Harbor.
Fort Leavenworth,	105	152	—47	Port Bowen.
Fort King,	106	156	—50	Igloolik.
Council Bluffs,	108	158	—53	Fort Franklin.
Fort Gratiot,	109	164	—55	Melville Island.
St. Louis,	109	166	—57	Fort Enterprise.
Fort Gibson,	116	186	—70	Fort Reliance.

It will be observed that the extraordinary degrees of heat do not belong to the extreme south, nor those of cold to the extreme north. The highest heat occurred a little below the thirty-sixth parallel, and the greatest cold as far below the sixty-third, only 27° of latitude apart; both stations lie west of the hydrographical axis of the Valley, in comparative proximity to the Rocky Mountains.

VIII. LESSER VARIATIONS.—This is not the place to discuss those vicissitudes of temperature which occur within a single year, or its subordinate divisions; but I may remark that, as the greater includes the less, so the more limited changes of temperature are, as it were, comprehended in the greater, which have been set forth. The causes of the whole are substantially the same, and in those regions where extreme librations occur, the monthly and daily vicissitudes are, of course, more frequent and violent. In the same latitudes, moreover, the range of mean temperature in different years is widest. The zone which presents this inconstancy in the highest degree, is that comprised between the thirty-fourth and the forty-fourth parallels, having mean temperatures varying from 60° to 45°. This, however, is the zone of densest population and greatest activity; demonstrating that vicissitudes of temperature are not unfavorable to human development.

SECTION III.

DISTRIBUTION OF THE MEAN ANNUAL TEMPERATURE THROUGH THE SEASONS.

I. TABLE OF THE SEASONS.—The following table, designed to show the mean temperature of the seasons, in various parts of the Interior Valley, does not embrace all the localities included in the general table of mean temperatures, which would be unnecessary, even if the observations which I have been able to collect were sufficient. As in the preceding table, so in this, we begin with southern and end with northern stations; but they are not presented in the same order, as it seems preferable to throw them into groups, or sections. The *first* includes maritime stations around the Gulf of Mexico; the *second*, interior or continental stations, east of the Gulf and the Mississippi River, up to latitude 42°, or the southern line of the great Lakes; the *third*, interior stations on the banks of that river, to the same parallel; the *fourth*, interior stations west of the Gulf and of that river, to the forty-second parallel; the *fifth*, interior stations above that parallel, and west of the northern Lakes; the *sixth*, interior stations above that latitude, and east of the Lakes; the *seventh*, lacustrine stations, from Ontario to Superior; the *eighth*, continental stations in the Hudson and Polar Basins, west of Hudson Bay; the *ninth*, marine stations in the same basins.

By this grouping, the influence of local conditions, as of seas and lakes, forests, savannas, and mountains, can, I suppose, be made more apparent, than if the stations had been placed in the order of the general table. The annual mean temperatures in this table, result from the seasons, and generally differ a little from those of the general table, as they represent a smaller number of years. The object is, to show the precise relation of the heat of the seasons to that of the year — not the absolute mean temperature. After giving the temperature of each season, the difference between winter and summer is stated in a separate column, followed by another, in which that difference is compared with the mean annual temperature, and expressed *per centum*. The numbers in this column, which do not rise to one hundred, indicate the *per centum*, or decimal proportion, which the differences between the temperatures of summer and winter bear to the annual heat; one hundred shows that they are equal; all above that number show by how much *per centum* the differences are greater than the mean heat. Another column presents the ratio at which the decrease of mean temperature, from advancing north, occasions an increase of divergence between winter and summer. In determining this ratio, 82° is taken as the maximum, or equatorial heat, and 3° as the minimum, or zero of equatorial divergence, of the winter and summer curves. The temperature of each station is then subtracted from 82°, and the remainder made a divisor; the range between summer and winter at the same station is of course the effect or resultant of that diminution, and after deducting from it 3°, for the equatorial divergence, the remainder is made a dividend. The quotient shows the ratio at which the reduction of annual mean temperature augments the range between winter and summer. The remaining columns of the table indicate the relations between the mean annual temperature and that of spring and autumn, taken separately, and, also, in conjunction; the excess or deficiency of the season, compared with the year, bein indicated by the sign + (plus), or — (minus).

MEAN TEMPERATURE OF THE SEASONS.

No. of the Gen. Table.	PLACES, DIVIDED INTO SECTIONS.	N. L.	W. L.	Altitudes in feet.	Mean Ann. Heat.	SEASONS. Mean heat of Wint.	Mean heat of Spr'g.	Mean heat of Sum'r	Mean heat of Aut'n	Diff. bet'n. Wint. and Sum'r	Ratio of diverg'e compar. to M. T.	Per ct. of diff. of W. & S. on M. T.	Heat of Spring ab've or below an. heat.	Heat of Aut'mn ab've or below an. heat.	Heat of S. & A. ab've or below an. heat.
	SECTION I. *Maritime: on the Gulf of Mexico.*	° ′	° ′		°	°	°	°	°	°	°	°	°	°	°
2	Cumana,	10 28	64 10	Sea.	81.32	80.60	83.48	82.18	79.02	4.46	2.14	5 48	+2.16	—2.30	—0.07
3	Vera Cruz,	19 12	96 09	"	77.49	71.96	77.90	81.50	78.62	9.54	1.45	12.31	+0.41	+1.13	+0.77
6	Havana,	23 10	82 23	"	77.34	72.68	76.28	82.32	78.08	9.64	1.42	12.46	—1.06	+0.74	—0.16
7	Ubajoy, near Havana,	23	82	247	73.52	64.79	71.12	83.04	75.12	18.25	1.80	24.82	—2.40	+1.60	—0.40
8	Key West,	24 34	81 52	Sea.	76.36	70.08	75.97	81.85	77.54	11.77	1.55	15.41	—0.39	+1.18	+0.39
9	Tampa Bay,	27 57	82 35	"	72.41	62.49	72.21	80.42	74.50	17.93	1.55	24.76	—0.21	+2.09	+0.94
10	Fort King,	28 58	82 05	50?	72.57	60.72	74.67	83.35	71.52	21.63	1.97	30.22	+0.10	—0.05	+0.02
14	Thirtieth Parallel,	30	90	"	70.00	55.23	70.91	83.04	70.78	27.81	2.09	39.73	+0.91	+0.78	+0.84
15	Pensacola,	30 21	87 14	"	67.66	55.33	68.44	81.52	65.33	26.19	1.62	38.70	+0.78	+2.33	—0.78
17	Baton Rouge,	30 36	91 33	50?	67.57	52.68	68.72	81.48	67.38	28.80	1.79	42.62	+1.15	—0.19	+0.48
18	Mobile,	30 42	87 59	"	70.29	57.26	70.13	82.75	71.01	25.49	1.92	36.26	—0.16	+0.72	+0.28
	Means,	2651	86 23		72.52	62.22	72.63	82.12	72.98	19.70	1.71	29.27	+0.13	+0.34	+0.23
	SECTION II. *Interior: east of the Mississippi.*														
23	Huntsville,	34 45	87	600?	59.38	42.15	59.96	75.62	59.79	33.47	1.34	56.36	+0.58	+0.41	+0.49
26	Nashville,	36 10	86 49	600?	58.55	39.98	59.90	77.25	57.08	37.27	1.46	63.65	+1.35	—1.30	—0.02
31	Portsmouth,	38 45	82 56	540	55.02	35.99	54.85	74.25	54.99	38.26	1.37	69.53	—0.17	—0.03	—0.10
32	Cincinnati,	39 06	84 29	543	53.36	33.25	53.87	73.19	53.16	39.94	1.29	74.85	+0.51	—0.20	—0.15
34	Marietta,	39 25	81 31	630	52.55	33.72	52.44	71.39	52.63	37.67	1.18	71.68	—0.11	+0.08	—0.02
36	Steubenville,	40 25	80 41	670	50.52	30.11	50.66	70.88	50.44	40.77	1.20	80.70	+0.14	—0.08	+0.03
37	Hudson,	41 15	82 28	1131	47.37	25.70	48.20	69.20	46.40	43.50	1.17	92.00	+0.80	—1.00	—0.10
	Means,	38 33	83 40		53.82	34.41	54.27	73.11	53.50	38.70	1.29	72.68	+0.44	—0.30	+0.02

MEAN TEMPERATURE OF THE SEASONS—CONTINUED.

No. of the Gen. Tab.	PLACES, DIVIDED INTO SECTIONS.	N. L.	W. L.	Altitudes in feet.	Mean Ann. Heat.	SEASONS. Mean heat of Wint.	Mean heat of Spr'g.	Mean heat of Sum'r	Mean heat of Aut'n	Diff. bet'n Wint. and Sum'r	Ratio of diverg'e compar. to M. T.	Pret. of diff. of W. & S. on M'n Temp.	Heat of Spring ab've or below an. heat.	Heat of Aut'mn ab've or below an. heat.	Heat of S & A. ab've or below an. heat.
	SECTION III. *On the banks of Mississippi to lat. of the Lakes.*	° ′	° ′		°	°	°	°	°	°	°	°	°	°	°
	Natchez,	31 34	91 28	264	67.00	52.18	67.81	80.96	67.06	28.78	1.71	42.90	+0.81	+0.06	+0.43
20	St. Louis,	38 37	90 16	450	55.28	33.98	56.55	76.19	54.38	42.21	1.46	76.35	+1.27	—0.90	+0.18
30	Bloomington,	41 26	91 10	500?	48.50	25.80	49.90	69.00	49.30	43.20	1.20	89.07	+1.40	+0.80	+1.10
38	Fort Armstrong,	41 32	89 42	580	50.65	25.15	50.82	74.57	52.07	49.42	1.47	97.57	+0.17	+1.42	+0.79
40	Means,	38 17	90 39		55.36	34.28	56.27	75.18	55.70	40.90	1.46	76.47	+0.91	+0.44	+0.62
	SECTION IV. *Int.: west of Gulf and Miss. to lat. of the Lakes.*														
4	City of Mexico,	19 26	99 06	7451	61.86	55.44	64.50	66.30	61.20	10.86	0.39	17.55	+2.64	—0.66	+0.99
5	Xalapa,	19 30	96 54	4330	67.64			69.32							
19	Fort Jesup,	31 30	93 47	100?	66.65	51.22	67.40	81.49	66.49	30.27	1.77	45.41	+0.75	—0.16	+0.29
22	Fort Towson,	33 53	94 13	300?	62.65	42.62	61.78	79.52	66.69	36.90	1.75	58.89	—0.87	+4.04	+1.58
25	Fort Gibson,	35 48	95 04	600?	61.12	42.50	61.26	79.17	61.53	36.67	1.61	60.00	+0.14	+0.41	+0.27
33	Fort Leavenworth,	39 23	94 44	912	52.34	27.60	54.39	74.00	53.38	46.40	1.46	88.65	+2.05	+1.04	+1.54
39	Council Bluffs,	41 28	95 45	1127	51.09	24.48	51.60	75.81	52.46	51.33	1.56	100.47	+0.51	+1.37	+0.94
	Means,	36 24	94 44		58.77	37.68	59.28	76.00	60.11	40.31	1.63	70.68	+0.51	+1.34	+0.92
	SECTION V. *Interior: West of the Northern Lakes.*														
54	Fort Crawford,	43 03	91 09	690	47.35	20.69	48.25	72.38	48.09	51.69	1.40	109.16	+0.90	+0.74	+0.82
59	Fort Winnebago,	43 31	89 28	800	44.89	20.81	44.67	67.97	46.10	47.16	1.19	105.05	—0.22	+1.21	+0.49

63	Fort Howard,	44 40	87 00	600	44.60	20.24	43.42	68.75	45.99	48.51	1.22	108.76	—1.18	+1.39	+0.10
65	Fort Snelling,	44 53	93 05	780	45.15	17.29	46.56	71.16	45.59	53.87	1.38	119.31	+1.41	+0.44	+0.92
	Means,	44 02	90 10		45.50	19.75	45.72	70.06	46.44	50.31	1.30	110.57	+0.23	+0.94	+0.58
	SECTION VI. *Interior: East of the Northern Lakes.*														
42	Cuba,	42 15	78 30	1502	41.44	22.04	37.00	63.50	43.24	41.46	0.95	100.04	—4.44	+1.80	—1.32
46	Prattsburg,	42 34	77 20	1494	45.23	25.89	43.75	64.60	46.67	38.71	0.97	85.58	—1.48	+1.44	—0.02
60	Lowville,	43 47	75 39	800	42.98	21.55	41.79	63.12	45.45	41.57	0.98	96.72	—1.19	+2.47	+0.64
62	Pottsdam,	44 40	75 01	394	43.83	19.52	43.82	66.51	45.49	46.99	1.15	107.21	—0.01	+1.66	+0.82
66	Montreal,	45 31	73 34	50	44.91	17.28	42.81	72.23	47.30	54.95	1.40	122.35	—2.10	+2.39	+0.14
69	Quebec,	46 49	71 16	Sea.	41.88	14.18	38.84	68.46	46.04	54.28	1 27	129.60	—3.04	+4.16	+0.56
	Means,	44 15	75 11		43.38	20.07	41.33	66.40	45.70	46.33	1.12	106.91	—2.06	+2.32	+0.13
	SECTION VII. *Lacustrine: on the Northern Lakes.*														
41	Fort Dearborn,	41 50	87 55	591	46.14	24.31	45.39	67.80	47.09	43.49	1.13	94.25	—0.75	+0.95	+0.10
43	Detroit Barracks,	42 19	82 58	600	46.96	27.62	45.16	67.33	47.75	39.71	1.04	84.56	—1.80	+0.79	—0.50
44	Fredonia,	42 26	79 24	708	46.97	29.61	43.15	63.73	51.39	34.12	0.89	72.64	—3.82	+4.42	+0.30
50	Fort Gratiot,	42 51	82 53	600	46.84	26.82	44.15	67.25	49.13	40.43	1.06	86.31	—2.69	+2.29	—0.20
56	Rochester,	43 07	77 51	506	46.49	26.64	44.53	66.56	48.22	39.92	1.04	85.86	—1.96	+1.73	—0.12
57	Lewiston,	43 09	77 10	280	47.81	29.37	44.90	67.43	49.54	38.06	1.02	79.66	—2.91	+1.13	—0.89
61	Madison Barracks,	43 57	76 04	250	46.54	25.21	44.21	67.74	49.03	42.53	1.11	91.38	—2.33	+2.49	+0.08
64	Penetanguishine,	44 48	80 40	600	45.24	22.70	41.13	69.91	47.20	47.21	1.20	104.35	—4.11	+1.96	—1.08
67	Mackinac,	45 51	85 05	728	40.02	19.26	36.16	61.60	43.08	42.34	0.94	105.85	—3.84	+3.08	—0.38
68	Fort Brady,	46 30	84 43	600	40.63	18.06	38.17	62.14	44.13	44.08	1.00	108.49	—2.46	+3.50	+0.52
	Means,	43 40	81 40		45.36	24.96	42.69	65.43	47.65	41.19	1.04	91.33	—2.66	+2.23	—0.21
	SECTION VIII. *Interior: west of Hudson Bay.*														
70	Cumberland House,	53 57	102 17	800	32.01	—4.62	31.37	67.80	33.49	72.42	1.38	226.24	—0.64	+1.48	+0.42
72	Chipewyan,	58 43	111 18	500	29.19	—3.67	23.96	62.41	34.08	66.08	1.19	226.37	—5.23	+4.89	—0.17
74	Fort Simpson,	62 11	121 32	256	25.70	-18.30	26.96	59.18	26.96	69.48	1.18	270.35	+1.26	+1.26	+1.26

MEAN TEMPERATURE OF THE SEASONS—CONTINUED.

No. of the Gen. Table.	PLACES, DIVIDED INTO SECTIONS.	N. L.	W. L.	Altitudes in feet.	Mean Ann. Heat.	SEASONS. Mean heat of Wint.	Mean heat of Spr'g.	Mean heat of Sum'r	Mean heat of Aut'n	Diff. bet'n. Wint. and Sum'r	Ratio of diverg'e compar. to M. T.	Per ct. of diff. of W. & S. on M. T.	Heat of Spring ab've or below an. heat.	Heat of Aut'mn ab've or below an. heat.	Heat of S. & A. ab've or below an. heat.
		° ′	° ′	°	°	°	°	°	°	°	°	°	°	°	°
76	Fort Enterprise, ...	64 28	113 06	850	14.19	-23.03	8.72	51.71	19.34	74.74	1.06	526.70	—5.47	+5.15	—0.16
77	Fort Franklin, ...	65 12	123 13	200	17.24	-16.60	14.05	50.40	21.12	67.00	0.98	388.63	—3.19	+3.88	+0.34
	Means,	60 54	114 17		23.67	-13 64	21.01	59.50	27.00	69.94	1.16	327.66	—2.65	+3.33	+0.34
	SECTION IX. *Northern Coasts and Islands.*														
71	Nain, ...	57 08	61 20	Sea.	26.28	—0.60	23.90	48.38	33.44	48.98	0.82	186	—2 38	+7.16	+2.39
78	Winter Island, ...	66 11	83 11	"	6.09	-23.29	2.65	32.00	13.00	55.29	0.69	908	—3.44	+6.91	+1.73
79	Igloolik, ...	69 20	81 53	"	3.43	-24.76	1.86	33.66	2.96	58.42	0 70	1703	—1.57	—0.47	—1.02
80	Felix Harbor, ...	70 00	91 53	"	3.60	-27.06	-6.30	38.03	9.69	65.09	0.79	1813	—9.89	+6.10	—1.89
81	Port Bowen, ...	73 14	88 55	"	3.67	-25.09	-5.74	34.92	10.58	60.01	0.73	1635	—9.41	+6.91	—1.25
82	Melville Island, ...	74 47	110 48	"	-0.27	-30.21	-4.93	36.09	-2.02	66 30	0.77	6657	—4.66	—1.75	—3 20
	Means,	70 42	91 20		3.31	-26.08	-2.49	34.94	6.84	61.02	0.73	2543	—5.79	+3.54	—1.12

II. Deductions.—The physician who is desirous of knowing the distribution of temperature throughout the seasons, in the different parts of the Interior Valley, will find much to satisfy his curiosity in this table. It presents a careful assemblage of nearly all the observations I have been able to collect; and, comprehending stations from the tropical to the polar seas, affords data for deductions of a comprehensive kind.

In the equatorial regions, the seasons present but little variation; and the difference between winter and summer, is not as great, as that between one hour and the next, in the temperate zone. In advancing to the north, the curves which indicate the temperatures of those seasons, immediately begin to diverge, and continue to separate wider and wider from each other, until we reach the fifty-third parallel of latitude. This divergence — another expression for the difference between winter and summer — proceeds *pari passu* with the decrease of mean annual heat; so that the individual who travels from south to north, is constantly subjected to a climate of less mean heat, and greater extremes of summer and winter temperature, than that he left behind. He cannot anywhere in the Valley enjoy a temperate summer, without encountering a rigorous winter and a low annual heat; nor a mild winter, without a hot summer, and high annual heat.

The ratio at which the range between winter and summer increases, with the decrease of the mean heat of the year, is not uniform; for varying conditions of the surface more or less modify it. The *actual* range at the different stations included in the seasonal table, may be seen in connection with their mean annual temperatures; and to compare one place with another, recourse may be had to the column in which the divergence is expressed *per centum* on the mean heat of the year at each place. The higher the *per centum*, the greater is the divergence, compared with the mean temperature. But there is another mode of contemplating this relation. In the column of ratios, we see the amount of increase of divergence, which results from one degree of diminished temperature; and, consequently, the higher the ratio, the greater is the divergence, compared with the mean annual heat. For example, Fort Crawford and Lewiston have each a mean annual temperature (rejecting fractions) of 47°, and this, subtracted from 82°, leaves 35°, which, it might be supposed, would give the same divergence for both; but Fort Crawford belongs to a group of inland stations (Sect. V), which have a mean ratio of 1°.30, while Lewiston is a member of the lake group (Sect. VII), the mean ratio for which is 1°.04. When we multiply 35° by these numbers, and subtract from each product 3°, for the divergence at the equator, we have as the results, a difference between winter and summer, at Fort Crawford, of 42°—at Lewiston, of 33°. Again: Suppose a copious and permanent spring, in the State of Arkansas, where no meteorological observations had been made, to indicate the mean annual atmospheric temperature to be 62°; let that number be subtracted from the equatorial maximum, 82°, and we have as the remainder 20°, which, being multiplied by 1°.63, the ratio for that region (Sect. IV), gives 32°.6, from which 3° must taken for equatorial divergence, leaving 29°.6, as the range of winter and summer divergence. But if a spring indicated the same temperature for a place east of the Mississippi, in the State of Alabama, where the mean ratio (Sect. II) is 1°.29, the resulting range would be only 22°.8, showing that the difference between winter and summer would be 7° less at the latter than at the former place, while their mean temperatures were the same.

From the equatorial belt up to the thirtieth parallel, which cuts the northern coast of the Gulf of Mexico, the ratio of divergence is greater than we find it further north. The number which indicates it, is 1°.71 for 1° of diminished annual heat. After that, when we look at the eastern, middle, and western lines of stations, up to the Lakes, or forty-second parallel of latitude, we find for the first* (Sect. II), a ratio of 1°.29; for the second (Sect. III), a ratio of 1°.46; for the third (Sect. IV), a ratio of 1°.63. Now, the first of these three lines of stations, extends from North Alabama to the northern part of Ohio, lying to the winter and summer windward of the Appalachian Mountains, at a great distance from the Rocky Mountains; the second, along the Mississippi River, between the States of Mississippi, Tennessee, and Illinois, on the one hand, and of Arkansas, Missouri, and Iowa, on the other; and the third, parallel to that river, on the great inclined plain which descends from those mountains, in Arkansas, Missouri, and Iowa. It follows, then, as a law of our climate, that between the Gulf of Mexico and the Northern Lakes, the difference between winter and summer, as we advance under the same parallel, from east to west, gradually widens. Existing observations clearly indicate this law; but are not sufficiently exact, to enable us to assign to each degree of longitude its precise influence.

Let us advance to the groups of stations north of those we have just considered. They lie nearly in the same longitudes with each other. The first, or eastern (Sect. VI), extends from Cuba to Quebec, and has a mean longitude of 75° 11′; the second (Sect. VIII) includes the northern Lakes, with a mean longitude of 81° 40′; the third (Sect. V) comprehends stations west of the Lakes, in mean longitude 90° 11′. For the first, the mean ratio is 1°.12; for the second, 1°.04; for the third, 1°.30. We see from these ratios that, as those of the three stations further south, are less than those of the more southern, or Gulf stations, so these are lower still, showing that, as we continue to advance north, a degree of diminished annual temperature produces less and less divergence of winter and summer. We also see, when we compare the region east of the Lakes, in New York and Canada, with that to their west, in Michigan, Wisconsin, and Minesota, that the mean rate of divergence augments from 1°.12 to 1°.38, which is an increase of twenty-three *per centum* of the latter over the former. But when we look at the lake-stations, the mean ratio of which is 1°.04, we see most distinctly the influence of large bodies of water, in limiting the range between winter and summer. To the east, the ratio is 1°.12, and from the

* Xalapa and the City of Mexico not included.

longitude of the lake-stations, it ought there to be 1°.17, instead of 1°.04, as observation makes it. From this depression, the ratio rises rapidly to 1°.30. Thus, in advancing westwardly, the ratio sinks and rises, while to their south, it constantly rises. Thus, the effects of the Northern Lakes, and the Rocky Mountains, on the divergence of winter and summer, are in opposite directions; and it follows that the more completely a place is inclosed in the former, the less will be the range between winter and summer; the further it is taken to the west, on the great plain which ascends to the latter, the greater will be the divergence — the latitude meanwhile continuing the same.

In the Hudson and Polar Basins, we have two groups of stations (Sects. VIII and IX), a comparison of which will complete this investigation. The former of these groups (Sect. VIII), lying far west and north-west of Hudson Bay, in the direction of the Rocky Mountains, has a ratio 1°.16, which is .14 less than the group south of it and west of the Northern Lakes, still showing that as we cross the continent, from south to north, the ratio diminishes. The latter group (Sect. IX) is maritime, and composed of stations in and around the Polar Sea. It lies immediately north of the lake-stations, and has a mean ratio .31 lower than theirs, making it the lowest of the whole Valley; which affords further evidence that, as we move from the tropical to the polar regions, the ratio of seasonal divergence for a degree of diminished temperature, gets less and less. But let us compare the two hyperborean groups with each other. Their difference of mean longitude is 9° 40′ — of mean ratio .43; that of the maritime group being .73 — of the continental, 1°.16. This gives a rise of ratio equal to .043 for each degree of longitude. This is a greater by .0105 than from the Lakes to the stations west of them; and shows that the polar seas have a still greater influence in restraining the divergence of winter and summer, than the Lakes. Nain, as lying remote from the other places of this group, is not included in forming the ratio.

Having investigated the relation between the mean temperature of the year and that of the solstitial seasons, or winter and summer, let us now turn to the equinoctial. Throughout the whole table, the difference between spring and autumn, taken separately and conjointly, is indicated by the signs *plus* and *minus*. It will be instructive to collect into one table the means of the different groups of stations.

Sections.	Spring.	Autumn.	Spring and Autumn.	Diff. bet. Spring and Autumn.
I.	+0.13	+0.34	+0.23	.21
II.	+0.44	—0.30	+0.07	.74
III.	+0.91	+0.44	+0.62	.47
IV.	+0.51	+1.34	+0.92	.83
V.	+0.23	+0.94	+0.58	.71
Mean,	+0.45	+0.35	+0.48	.59
VI.	—2.06	+2.32	+0.13	4.38
VII.	—2.66	+2.23	—0.21	4 89
VIII.	—2.65	+3.33	+0.34	5.98
IX.	—5.79	+3.54	—1.12	9.33
Mean,	—3.29	+2.85	—0.34	6.14
Mean of the whole,	—1.22	+1.58	+0.17	3.06

When we take the means of the nine groups of stations, we find that, through the entire Valley, from the tropical to the polar regions, the temperature of spring is 1°.22 below the mean temperature of the year; that of autumn, 1°.58 above; and that of spring and autumn united, 0°.17 above. This small excess does not oppose the conclusion that, taking the Valley as a whole, the mean temperature of spring and autumn combined, is identical with the mean heat of the year. It is interesting to observe that, until we come to the last group of stations (Sect. IX), in the extreme north, the average heat of spring and autumn, in none of the groups, varies a degree from the annual temperature. But the table gives us information of a different kind.

In looking at the column for spring, we see that in the first five sections, the heat of that season is less than half a degree above the mean yearly heat of the same sections. These sections include all the stations in the Valley, from Vera Cruz and Havana to the southern shores of Lake Erie, on the east side of the Mississippi, and also the country up to Fort Snelling, on the western side of that river. Their high mean temperature indicates an early opening of spring, and a rapid advance of summer. When we pass on to the remaining groups (Sects. VI, VII, VIII, and IX), we find an entire change in the temperature of that season, in its relation to the annual heat, below which it ranges from 2°.06 to 5°.79.

Let us now institute some comparisons of a different kind. The most eastern section (VI) embraces stations north-east of Cuba, in N. Lat. 42° 15′, to Quebec, in N. Lat. 46° 47′. Its spring temperature falls 2°.06 below its mean annual heat; while the corresponding region (Sect. V), to the west of the great Lakes, has a spring, which rises .23 above the mean temperature of the year, making a difference between the two of 2°.29. To what should this be ascribed? Physical geography furnishes the answer, and shows, at the same time, the necessity of connecting its study with that of climatology. *First,* the western stations lie to the windward of the great lakes; and, *second*, they are in the midst of a boundless plain, which inclines to the south. On the other hand, the stations to the east lie to the leeward of the Lakes, which remaining cooled much longer than a terrestrial surface, retard the opening and advance of spring, wherever the winds blowing over them are felt; *second*, they are in the immediate vicinity of the high Adirondack mountains of New York, or other portions of the Appalachian Chain, to the south and north of that alpine group, and the currents of air which roll down, counteract the influence of the sun upon the plain; and, *third*, the general declination of the plain is to the north.

The next group (Sect. VII) includes the lake-stations, the average mean temperature of which is 2°.66 below that of the year. This difference may be ascribed almost entirely to the influence of the lakes, which is of course greater in places situated on their coasts than those more remote, although to their leeward. The ice formed in their shallow bays and coves is slow in melting; the whole body of water is cooled, in many parts almost to the freezing point; the rivers pour into them melted snows; Lake Superior sends down from a high latitude a copious supply of ice-water; and the exhalations which they send up form mists, and fogs, and clouds, which intercept the rays of the sun* — causes quite sufficient to account for the low temperature of spring.

In the distant north-west, the group (Sect. VIII) presents an average for spring 3°.33 below that of the year. In the (comparative) contiguity of these stations to the northern portions of the Rocky Mountains, and also to the polar seas, we find at once an explanation of the low temperature of spring.

The last group (Sect. IX) consists of sea-side and insular stations, chiefly within the Arctic Circle and the area of the Pole of Cold. Their average vernal temperature is no less than 5°.79 below the annual. Spring is indeed almost annihilated. The snows and ices of winter are but partially melted at midsummer, and it is not until the approach of the solstice that the earth is sufficiently thawed and warmed at the surface (still remaining frozen beneath) to permit vegetation to come forth.

We must now turn to autumn. With one exception, we find the heat of autumn greater than that of the year, in all the groups of stations; and in in that instance (Sect. II) it is only three-tenths of a degree below the annual heat. Nevertheless autumn is not uniform in this relation to mean annual temperature; for in the same group of stations, some present it above, others below, mean yearly heat. The group in which the greatest proportional number of stations present it below, is the second, extending from Huntsville, in North Alabama, to Lake Erie. But few stations on the opposite, or western, side of the Mississippi, have an autumnal temperature below that of the year; and all the groups present an average above yearly heat; from which it appears that between the latitudes of 30° and 42°, the western portions of the Valley have warmer autumns compared with

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* Professor Dewey: New York Reports.

the year, than the eastern. This may probably be ascribed to a deeper heating of the earth, by the rays of the summer sun having acted on a dry and treeless surface; but perhaps some portion of it may be attributed to the extensive conflagrations which, in that season of the year, run over the boundless prairies which stretch off to the Rocky Mountains. As in the case of spring, we find the autumnal heat of the first five groups to vary but little from the annual temperature; while in the remainder it is great; but in every group in the opposite direction, that is above, while that of spring is below, and their divergence from mean temperature is nearly to the same extent. The cause of a warm autumn in the stations around and to the leeward of the Northern Lakes (Sect. VII and VI), must be found in the Lakes themselves, which retain their summer temperature for a longer time than the earthy surface, and thus retard the approach of winter. The same explanation is perhaps applicable to the stations in Section IX, which are on the shores of the Polar Sea; but why the stations in Section VIII, which lie between Hudson Bay and the Rocky Mountains, should have an autumn of high temperature compared to their annual heat, does not so clearly appear.

The last column of the small table, which has supplied data for the deductions which have been made, presents the differences between spring and autumn without any reference to the mean temperature of the year. This difference, it will be seen, is less than a degree in the first five groups, and least of all in the first, or gulf-section, where it amounts only to about two-tenths of a degree. But when we advance into the other sections, the difference suddenly becomes much greater, and continues to increase up to the Pole of Cold. In the region east of the Lakes, to Quebec, it is 4°.38; among the Lakes, 4°.89; in the high north-west, 5°.98; in the polar maritime region, 9°.30. This divergence of spring and autumn is, of course, the effect of those causes which retard the coming on of the former, and the passing away of the latter season. In proportion to their difference, the points of time in spring and autumn, which have a mean temperature corresponding with that of the year, lie at a greater distance from the equinoxes, and consequently approach nearer to the solstices, than where the difference between the two seasons is less.

SECTION IV.

DISTRIBUTION OF TEMPERATURE THROUGH THE MONTHS.

I. Tabular View.—The table of months does not embrace as many places as that of the seasons, from the want of the necessary materials. Like that table, this does not present the mean annual heat given in the general table of temperatures, but that which results from the months themselves. After the columns presenting the mean heat of each month, there is another, in which the difference between the coldest and hottest months, with their names, is set down; and another, in which the ratio of that difference to mean temperature has been calculated by the method adopted for the seasons, which it is unnecessary to repeat or explain. To these columns three others are added, in which the excess or defect of mean temperature of the months following the equinoxes (April and October), separately and conjointly, are compared with that of the year. In constructing this table, I have not given the latitudes, longitudes, and elevations of the places; but by the aid of the numbers in the first column, they may be readily found in the general table of mean temperatures, or in that of the seasons.

MEAN TEMPERATURE OF THE MONTHS.

Number.	PLACES, in Sections, as in the Table of Seasons.	Mean Temperature.	January.	February	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec.	Names of the coldest and hottest Months.	Diff. bet'n them	Ratio of divg. M.T	April abv. or below M. T.	Oct'r abv. or below M. T.	A & O. abv. or below M. T.
		°	°	°	°	°	°	°	°	°	°	°	°	°		°	°	°	°	°
	SECTION I.																			
2	Cumana, ...	81.32	80.40				84.56								Jan. and May.	4.16	0.36			
6	Havana, ...	77.34	69.98	71.96	75.74	78.98	83.58	84.12	84.30	85.84	83.04	79.52	75.56	71.78	Jan. and Aug.	14.32	2.21	+1.64	+2.18	+1.91
7	Ubajoy (near Hav.),	73.52	64.50	67.50	66.87	70.00	76.50	82.25	83.62	83.25	79.62	76.50	69.25	62.37	Jan. and Dec.	21.25	2.03	—3.52	+2.98	—0.27
8	Key West, ...	76.55	69.46	70.26	80.83	75.35	78.98	81.03	82.55	81.98	81.19	77.21	74.22	70.52	Jan. and July.	13.09	1.65	—1.20	+0.66	—0.27
9	Tampa Bay, ...	73.40	63.03	65.78	68.56	72.79	77.99	80.79	81.74	81.23	79.95	75.23	69.06	64.42	Jan. and July.	18.66	1.70	—0.61	+1.83	+0.61
11	New Orleans, ...	70.19	56.42	59.17	68.60	73.71	78.96	83.09	83.90	83.27	80.23	71.69	60.81	54.38	Dec. and July.	29.52	2.16	+3.52	+1.50	+2.51
15	Pensacola, ...	68.36	52.91	55.83	59.63	67.18	76.09	80.33	81.02	81.06	77.47	69.92	61.68	54.83	Jan. and Aug.	28.15	1.77	—1,18	+1.56	+0.19
18	Mobile, ...	70.29	57.59	57.90	62.40	70.64	77.45	81.64	83.68	82.91	79.99	69.55	62.59	56.30	Dec. and July.	27.38	2.00	+0.35	—0.74	—0.19
	Means	72.81	62.84	64.06	68.95	72.66	78.51	81.87	82.97	82.79	80.21	74.23	67.60	62.11			1.93			
	SECTION II.																			
23	Huntsville, ...	59.73	42.06	42.59	51.34	61.30	67 25	74.23	76.39	76.21	70.15	59.50	49.74	41.81	Dec. and July.	34.58	1.37	+1.57	—0.23	+0.67
26	Nashville, ...	58.46	38.22	40.80	49.43	61.92	68.33	76.48	79.47	75.77	70.80	55.29	45.14	39.63	Jan. and July.	41.25	1.58	+3.46	—3.17	+0.14
31	Portsmouth, ...	55 36	34.50	36.62	45.54	54.58	64.62	72.15	75.35	74.74	65.54	59.19	44.99	37.96	Jan. and July.	41.45	1.45	—0.78	+3.83	+1.52
32	Cincinnati, ...	53.36	33.50	33.15	42.94	55.35	63.33	70.86	75.47	73.25	65.46	52.30	41 71	33.09	Dec. and July.	42.38	1.34	+1.99	—1.06	+0.46
34	Marietta, ...	52.91	32.53	34.01	43.16	52.61	61.54	69.60	73.72	70 84	63.62	52.11	42.16	34.62	Jan. and July.	41.19	1.28	—0.30	—0.80	—0.55
37	Hudson, ...	47.40	23.70	28.60	38.70	49.50	56.40	66.00	72.00	68.90	57.60	48.70	33.00	24.70	Jan. and July.	48.30	1 28	+2.10	+1.30	+1.70
	Means	54.54	34.09	35.96	44.35	55.88	63.58	71.55	75.40	73.29	65.53	54.51	42.79	35.30			1.38			
	SECTION III.																			
20	Natchez, ...	66.86	52.27	54.51	59.66	69.85	74.52	80.71	81.32	80.85	77.18	67.01	56.98	49.73	Dec. and July.	31.59	1.82	+2.99	+0 15	+1.57
30	St. Louis, ...	55.57	33.19	34.93	44.34	58.99	66.32	73.79	78.43	76.34	68.14	54.92	40.07	33.82	Jan. and July.	45.24	1.56	+3.42	+0.65	+1.38
38	Bloomington.	48.50	24.30	27.30	36.20	53.90	59.70	67.31	70.40	69.30	62.30	49.80	35.70	25.90	Jan. and July.	46.10	1.26	+5.40	+1.30	+3.35
40	Fort Armstrong, ..	50.65	23.78	26.28	37.47	51.26	63.83	73.59	77.92	76.21	63.67	54.58	39.82	30.53	Jan. and July.	54.14	1.60	+0.61	+3.93	+2.27
	Means	55.40	33.38	35.75	44.42	58.50	66.09	73.85	77.02	75.67	67.82	56.48	43.34	35.00			1.56			
	SECTION IV.																			
4	City of Mexico, ..	61.86	54.14					67.46							Jan. and June.	13.32	0.46			
19	Fort Jesup, ...	67.90	52.30	54.09	61.79	66.81	75·20	80.95	83.54	82.96	77.14	68.29	58.55	53.17	Jan. and July.	31.24	1.93	—1.09	+0.39	—0.35
25	Fort Gibson.	61.07	45.47	41.25	53.51	61.28	72.69	78.65	81.49	83.28	74.61	65.95	54.12	46.20	Feb. and Aug.	42.03	1.81	+0.21	+4.88	+2 54
39	Council Bluffs, ...	51.08	24.61	26.59	37.43	51.82	66.56	73.98	77.38	76.11	65.24	53.65	38.50	24.21	Dec. and July.	53.17	1.59	+0.74	+2.57	+1.65
	Means	60.02	40.79	40.64	50.91	59.97	71.48	77.86	80.80	80.78	72.33	62.63	50.39	41.19			1.77			

	SECTION V.																		
54	Fort Crawford,....	47.35	19.72	21.93	32.48	43.92	59.45	68.57	72.40	71.41	61.50	45.45	33.06	18.04	Dec. and July.	54.36	1.45	—3.43	—1.90	—2.66
63	Fort Howard,.....	44.98	18.14	20.16	31.19	43.28	57.13	68.38	72.25	68.86	57.61	47.51	34.29	21.00	Jan. and July.	54.11	1.35	—1.70	+2.53	+0.41
65	Fort Snelling,.....	45.15	13.58	18.66	32.12	46.00	62.11	70.83	75.47	71.98	59.41	49.27	33.36	15.60	Jan. and July.	61.89	1.57	+0.85	+4.12	+2.48
	Means	45.83	17.15	20.25	31.93	44.40	59.57	69.26	73.37	70.75	59.51	47.41	33.57	18.21			1.46			
	SECTION VI.																		
42	Cuba,............	41.41	22.07	17.46	25.40	37.15	48.45	64.29	63.05	63.17	58.93	37.42	33.37	26.58	Feb. and June.	46.83	1.05	—4.26	—3.99	—4.12
46	Prattsburg, ...	45.23	26.37	23.38	32.39	46.67	52.19	61.43	66.23	66.14	59.74	45.56	34.73	27.92	Feb. and July.	42.85	1.05	+1.44	+0.33	+0.88
60	Lowville, ...	42.98	20.73	20.08	29.65	43.96	51.77	60.64	64.81	63.92	60.14	43.47	32.75	23.85	Feb. and July.	44.73	1.04	+0.98	+0.49	+0.73
62	Pottsdam, ...	43.83	16.80	19.54	30.57	46.65	54.29	64.04	68.22	67.26	58.92	44.34	33.22	22.23	Jan. and July.	50.46	1.21	+2.82	+0.51	+1.66
66	Montreal, ...	44.90	14.66	18.13	28.43	41.94	58.06	68.12	78.89	69.67	60.23	47.43	33.83	18.96	Jan. and July.	64.23	1.62	—2.96	+2.53	—0.21
69	Quebec,..........	41.88	10.98	14.83	28.33	39.40	53.58	65.27	71.29	70.77	57.50	43.70	34 32	12.64	Jan. and July.	60.41	1.40	—2.48	+1.82	—0.33
	Means	43.37	18.60	18.90	29.13	42.63	53.06	63.96	68.75	66.82	59.24	43.65	33.70	22.03			1.23			
	SECTION VII.																		
44	Fredonia, ...	46.97	29.47	27.89	34.07	47.06	48.33	51.26	69.97	69.95	63.07	50.35	40.74	32.46	Feb. and July.	42.08	1.09	+0.09	+3.38	+1.73
56	Rochester, ...	46.42	26.43	25.43	32.73	44.92	55.95	64.32	69.31	66.10	60.09	47.26	37.31	28.05	Feb. and July.	43.88	1.12	—1.50	+0.84	—0.33
68	Fort Brady,......	40.62	18.68	19.80	27.37	38.50	52.56	59.13	65.90	64.52	56.25	45.52	33.91	22.28	Jan. and July.	47.22	1.04	—2.12	+4.90	+1.39
	Means	44.67	24.86	24.37	31.39	43.49	52.28	58.23	68.39	66.86	59.80	47.71	37.32	27.60			1.08			
	SECTION VIII.																		
70	Cumberland House,	32.01	—14.19						73.73						Jan. and July.	87.92	1.68			
72	Fort Chipewyan,..	29.19	— 9.56						65.70						Jan. and July.	75.26	1.35			
75	Fort Reliance, ...	21.47	—25.00	-18.84	-6.14	8.23	36.03					20.70	13.43	-17.07	Jan. and ——					
76	Fort Enterprise, ..	14.19								55.36				-29.12	Dec. and Aug.	84.48	1.18			
77	Fort Franklin,....	17.24	—23.78						52.10						Jan. and July.	75.88	1.11			
	Means	22.82															1.33			
	SECTION IX.																		
71	Nain,............	26.42		-11.20					51.80							63.00	1.06			
78	Winter Island,....	6.09	—25.96	-27.97	-14.64	2.51	20.09	30.97	32.86	32.14	24.75	9.51	4.75	-15.94	Feb. and July.	60.83	.75	—3.58	+3.42	—0.08
79	Igloolik,..........	1.85	—20.07	-23.41	-22.75	-4.68	21.85	29.16	33.34	30.68	21.45	9.79	-22.37	-30.80	Dec. and July.	64.14	.75	—2.83	+7.94	+2.55
80	Felix Harbor,.....	3.60	—26.73	-32.02	-32.01	-2.54	15.64	34.16	41.25	38.69	25.41	9.07	-5.42	-22.43	Feb. and July.	73.27	.88	—6.14	+5.47	—0.33
81	Port Bowen,......	3.62	—28.91						37.29						Jan. and July.	66.20	.79			
82	Melville Island, ...	0.27		-35.05					40.98						Feb. and July.	75.93	.87			
	Means	-3.00															.85			

Much of what has been said on the seasons, is applicable to the months; for while January and July are representatives of winter and summer, April and October are representatives of spring and autumn, with this difference, however, that the two former months represent the extremes, the two latter, the mean of annual heat. Let us consider them in succession.

II. Summer Months.—The month of July is, at almost every station embraced in the table, as that of highest mean temperature. The curve of 80°, or upward, for this month, reaches as high as Natchez, on the Mississippi River, and Fort Gibson, west of it; the latter being in N. Lat. 35° 47′. To what parallel it attains east of the Mississippi is not known, from the want of observations. It does not reach Huntsville (nearly in the same latitude with Fort Gibson), the July temperature of which town is 76°.39, or 6°.89 below that of the hot month, at the western military post. The curve of 75°—80° reaches Fort Snelling, in the west, N. Lat. 44° 53′, and Montreal, to the east, in Lat. 45° 31′, which even has a higher temperature by 3°.42, although two-thirds of a degree further north; but this may result from a difference of seven hundred feet in their altitudes above the sea. There is no place between them, which has an equal temperature. The curve of 70°—75° passes above every place south and west of the Northern Lakes. On the western side of the Valley, it even extends to Cumberland House, N. Lat. 53°, where from one year's observations, it is 73°.73. To the east of the Lakes, while it passes south of Cuba and Prattsburg, in consequence of their great elevation, it comes nearer to Pottsdam, at a lower level, though further north, and strikes beyond Quebec, the July temperature of which is 71°.29, while its latitude is 46° 47′. By the Lakes it is kept to the south, as none of the stations mentioned in the table present a heat of 70°, although they are not so far north as many stations included in it. When we compare the stations east of the Mississippi River, extending from Alabama to Ohio, inclusive, with those along that river, and to its west, we find an average heat of 6° or 7° greater, in the latter ranges than the former; and doubtless when observations shall be made still further west, on the great prairies, the difference will be augmented. The causes of this difference have been already assigned, when treating of the seasons.

It is known, that, as we advance north from the Gulf of Mexico, the summers shorten at a greater ratio than the intense heat abates. This implies a decrease in June or August, or both, at a higher ratio than in July; and such, on the whole, is the fact. In the hot climates, the three months approach nearer to the same standard, than in the temperate and colder regions. This will appear from the following table, which includes stations from Havana to Quebec, arranged nearly in the order of their latitudes:

PLACES.	M. T. OF JUNE.	M. T. OF JULY.	M. T. OF AUGUST.	JUNE BELOW JULY.	AUGUST BELOW OR ABOVE JULY.
	°	°	°	°	°
Havana,	84.12	84.30	85.84	—0.18	+1.54
Ubajoy,	82.25	83.62	83.25	1.37	—0.37
Key West,	81.03	82.55	81.98	1.52	—0.57
Pensacola,	80.33	81.02	81.06	0.69	+0.04
Fort Jesup,	80.95	83.54	82.96	2.59	—0.58
Fort Gibson,	78.65	81.49	83.28	2.84	+1.79
Huntsville,	74.23	76.39	76.24	2.16	—0.15
St. Louis,	73.79	78.43	76.34	4.64	2.09
Cincinnati,	70.86	75.47	73.25	4.61	2.22
Marietta,	69.60	73.72	70.84	4.12	2.88
Hudson,	66.00	72.00	68.90	6.00	3.10
Council Bluffs,	73.98	77.38	76.11	3.40	1.27
Bloomington,	67.30	70.40	69.30	3.10	1.10
Fort Crawford,	68.57	72.40	71.41	3.83	0.99
Fort Snelling,	70.83	75.47	71.98	4.64	3.49
Rochester,	64.32	69.31	66.10	4.99	3.21
Pottsdam,	64.04	68.22	67.26	4.18	0.96
Montreal,	68.12	78.89	69.67	10.77	9.22
Quebec,	65.27	71.29	70.77	6.02	0.52
Fort Brady,	59.13	65.90	64.52	6.77	1.38

From this table it will be seen, that the heat of August approaches nearer than that of June, to the hottest month. At three southern stations it is even greater, as indicated by the sign plus. Taking the mean of all the stations, it is but 1°.45 below that month; but June is 3°.77 below. It also appears that, as we advance north, with the single exception of Montreal, the heat of August keeps up its near approach to that of July. But there is a manifest decline in that of June. The shortening of summer, then, in the higher latitudes, results chiefly from the diminishing temperature of that month, and not of that month and August combined.

III. WINTER MONTHS.—The relation of these months to each other, will appear from the following table, embracing the same places with the last:

PLACES.	M. T. OF DECEM.	M. T. OF JANUARY.	M. T. OF FEB'ARY.	DECEMBER, BELOW OR ABOVE JAN.	FEBRUARY, BELOW OR ABOVE JAN.
	°	°	°	°	°
Havana,	71.78	69.98	71.96	+1.80	+1.98
Ubajoy,	62.37	64.50	67.50	—2.13	+3.00
Key West,	70.52	69.46	70.26	+1.06	0.80
Pensacola,	54.83	52.91	55.83	1.92	2.92
Fort Jesup,	53.17	52.30	54.09	0.87	1.79
Fort Gibson,	46.20	45.47	41.25	0.73	—4.22
Huntsville,	41.81	42.06	42.59	—0.25	+0.53
St. Louis,	33.82	33.19	34.93	+0.63	1.74
Cincinnati,	33.09	33.50	33.15	—0.41	—0.35
Marietta,	34.62	32.53	34.01	+2.13	+1.48
Hudson,	24.70	23.70	28.60	1.00	4.90
Rochester,	28.05	26.43	25.43	1.62	—1.00
Council Bluffs,	24.21	24.61	26.59	—0.40	1.98
Bloomington,	25.90	24.30	27.30	+1.60	3.00
Fort Crawford,	18.04	19.72	21.93	—1.68	2.21
Fort Snelling,	15.60	13.58	18.66	+2.02	5.08
Pottsdam,	22.23	16.80	19.54	5.43	2.74
Montreal,	18.96	14.66	18.13	4.30	3.47
Quebec,	12.64	10.98	14.83	1.66	3.85
Fort Brady,	22.28	18.68	19.80	3.60	1.12

It appears from this table that, taking the mean of all the stations, the month of December rises 1°.27 above January—that of February 1°.85. Thus, the distribution of heat among the winter months is more equable than among the summer; for while August bears a relation to July similar to that of December and February to January, June falls below July, more than two and a half times further than August does. Hence we learn, that the heat increases more after the summer solstice, than it diminishes after the winter solstice, in the proportion of 3°.77 to 1°.27. Another point in which the winter months, compared with each other, differ from the summer, when compared in the same manner, is that neither December nor February recedes from January with the same regularity, or to the same extent, as June from July. Still we see that below Cincinnati, in the thirty-ninth parallel, the difference between December and January is less than above; but to February the remark is scarcely applicable.

The curve for the month of January, = 32°, passes a little north of Marietta, in Lat. 39° 25′; all the stations north of that latitude have a mean heat below 32°; all south of it, above 32°.

When we bring together the coldest months at different places, nearly agreeing in latitude, but differing in longitude, we have the following exhibit:

Eastern.	°	Western.	°
Huntsville,	41.81	Fort Gibson,	41.25
Portsmouth,	34.50	St. Louis,	33.19
Hudson,	23.70	Council Bluffs,	24.21
Rochester,	25.43	Fort Crawford,	18.04
Pottsdam,	16.80	Fort Howard,	18.14
Montreal,	14.66	Fort Snelling,	13.58
Quebec,	10.98	Fort Brady,	18.68

The similarity of these amounts, does not well accord with the popular opinion, which ascribes a more intense degree of cold to the western, than the eastern side of the Mississippi. The observations here given are too few to settle the question; but we must remember the greater velocity of the wind on the prairies of the Missouri plain, and its consequent effect on the feelings of individuals, not less than the streams from which it promotes a rapid evaporation. The remarkable difference between Rochester and Fort Crawford, and Quebec and Fort Brady, shows the warming influence of the Lakes in winter.

IV. Spring Months.—Of the vernal months, April approaches nearest to the mean temperature of the year, being sometimes above, and sometimes below it, at the same place. On the whole, it rises above something oftener in the south than the north. In the neighborhood of the Lakes, it is generally at or below mean temperature; at the northern margin of the continent, near or within the Arctic Circle, constantly below; in both cases showing the influence of large bodies of water in retarding the opening of spring. Varying so little from the mean annual temperature, April is seldom called a hot month. An inspection of the table shows that the transition from March to April is much greater than from February to March. March, indeed, belongs to winter rather than summer; but its temperature never falls as low as that of February. As we advance from south to north up the Valley, the change from March to April becomes more and more violent, and has its maximum at the Polar Sea. The transition from April to May, is nearly as great as from March to April, and likewise increases from south to north. It is by this rapid movement, that the air, and waters, and earth, are redeemed from the ices of winter, in time for a thousand purposes that could not be accomplished if the increase of heat were more gradual. A slower increase of daily heat would, it is true, prolong the delicious pleasures of spring; but at the same time lengthen the prevalence of vernal intermittents, and abridge the productiveness of summer and autumn. A rigorous winter demands a rapid development of spring. As March participates in the character of winter, so May is allied to summer. The transition from that month to June, as indicated by the mean temperatures of the two, throughout the Valley, is nearly fifty *per centum* less than from March to April, or from April to May; and the increase of the difference between the last month and June, as we advance from south to north, is in the same proportion. In the middle latitudes of the Valley, the temperature of the last third of this month generally varies widely from the first third. Frost almost always occurs in the latter; the former is frequently as hot as June. The middle sometimes leans to one, sometimes to the other extreme.

In the distant north, the transition from winter to summer, is at a rate altogether unknown in the other portions of the Valley. At Cumberland House, Lat. 53°, the difference between February and March is 12°; between March and April, 14°; between April and May, 28°. At three places, near or within the Arctic Circle, the average of the transition from March to April was 21°; from April to May, 20°; from May to June, 12°. By such an increase it is, that spots which in March had a mean heat 23° below zero, were in June embossed with flowers.

V. Fall Months.—October is, among the months of autumn, what April is among those of spring. In all parts of the Valley, its heat approaches nearer to that of the year, than any other fall month; and its temperature is the most acceptable to the feelings. At nearly all the stations, it ranges above mean annual heat. In the southern and middle latitudes, this excess is nearly the same; but in the Polar Basin it is greater. The transition from August to September is less rapid, than from September to October; from the latter to November it continues the same, that is, the rate of cooling from September to November, inclusive, continues constant; but the transition from November to December is at a lower ratio, and does not differ materially from that between August and September. In comparing the autumnal with the vernal ratios, they are found to be substantially the same. They further agree in this, that they are greater in the middle than the southern latitudes, a necessary requirement of the greater difference between winter and summer in the former than the latter. As March, throughout most of the Valley, belongs rather to winter than summer, so September has greater affinities to summer than winter; and as May has sometimes a rival temperature to that of June, so November is occasionally nearly as cold as December. The true spring and fall seasons, are the sixty days immediately succeeding the equinoxes. In deliciousness of climate they constitute the finest portions of the year; but the latter is productive of autumnal fever.

These conclusions relate to the Mexican and St. Lawrence Basins; in the Polar, while the transition from August to September is about the same as further south, the transition from one to the other of each of the succeeding months is much more rapid.

VI. Divergence of the hottest from the coldest Month, compared with Summer and Winter.—In the preceding section we saw, that as we advance north, and the mean temperature of the year diminishes, the range between winter and summer increases. I propose now to inquire into the divergence, under the same circumstances, of the hottest from the coldest month, compared with the seasons of which they are the maximum and minimum. To do this, I have collected into a table the ratios of divergence of summer from winter, and of July from January, for one degree of lessened annual heat, making an average of each, for the different sections in the seasonal and monthly tables.

RATIOS OF THE DIVERGENCE OF THE MEAN HEAT OF WINTER AND SUMMER, AND OF THE COLDEST AND HOTTEST MONTH, FROM THE LOSS OF 1° OF MEAN YEARLY TEMPERATURE.

Groups of Places.	Seasons.	Months.	Difference.
	°	°	°
Sect. I. Around the Gulf of Mexico,	1.71	1.93	0.22
II. East of Mississippi, to N. L. 42°,	1.29	1.38	0.11
III. Along " "	1.46	1.56	0.10
IV. West of " "	1.63	1.77	0.14
V. West of the Northern Lakes,	1.30	1.46	0.16
VI. East of the "	1.12	1.23	0.11
VII. Among the "	1.04	1.08	0.04
VIII. Bet. Hudson B. and Rocky Mts.,	1.16	1.33	0.17
IX. Polar Seas,	0.75	0.85	0.10

To use this table, the mean temperature of the place must be subtracted from 82°, the equatorial heat, and the difference multiplied by the two ratios of the group or section, to which, according to the general table of mean temperatures, the place belongs. The difference of the products is the extent to which the monthly divergence exceeds the seasonal. It may be well to illustrate by a few examples. A place lying east of the Northern Lakes (Sect. VI), may have a temperature of 44°. If this be subtracted from 82°, it leaves 38°, which, multiplied by the seasonal ratio of that section, 1°.12, gives 42°.56 — by the monthly, 1°.23, gives 46°.74; showing that the months of January and July diverge 4°.18 beyond the winter and summer seasons. If the same process be employed for a place having the same mean heat, but lying among the Lakes (Sect. VIII), where the ratios are for the seasons 1°.04, and for the months 1°.08, we obtain as the results 39°.52 and 41°.04; finally, if we proceed with the same mean temperature into the region west of the Lakes, where the ratios are 1°.30 and 1°.46, we get, as products, 49°.40 for the seasons, and 55°.48 for the months. It will be instructive to throw these results into a tabular form:

RANGE FROM WINTER TO SUMMER, AND FROM JANUARY TO JULY, THE MEAN ANNUAL TEMPERATURE BEING 44°.

Localities.	Seasons.	Months.	Difference.
	°	°	°
Sect. VI. East of the Northern Lakes,	42.56	46.74	4.18
VII. Among the "	39.52	41.04	1.52
V. West of the "	49.40	55.48	6.08

We observe by this table, that the Lakes exert a decidedly restraining influence on the range between winter and summer, and a still greater on the divergence of July from January; we also perceive that both the seasonal and monthly ranges are greater in the plains west of the Lakes, among the tributaries of the Mississippi, than in the valley of the St. Lawrence to their east. By a similar comparison, between the places east of the Mississippi (Sect. II), and those west (Sect. IV), we ascertain that the ranges of winter and summer, and the coldest and hottest month, are greater in the latter than the former region.

VII. Comparative Range of the coldest and hottest Months, from mean Temperature.—Having considered the coldest and hottest months, in connection with the other months of winter and spring, we continue their study, by inquiring into their relative distance from mean annual temperature. This may be understood by the following table. Its first column presents an average of the mean temperature of the different stations of each group, or section of the Table of Months; the second, average range between the coldest and hottest months of the same; the third, shows the distance to which the average of the coldest months falls below the mean annual temperature; the fourth, the distance to which the average of the hottest months rises above; the fifth, the greater divergence from mean yearly heat, of the average of the coldest, than of the hottest months; the sixth, the greater divergence, from the same temperature, of the average of the hottest than of the coldest months.

Sections of the Table of Months.	Annual average Mean Temp.	Range between coldest and hottest months.	Coldest month below M. T.	Hottest month above M. T.	Excess of coldest over hottest in distance fm. M. T.	Excess of hottest mo. over coldest, in dis. from M. T.
	°	°	°	°	°	°
I.	72.81	20.86	10.70	10.16	.54	——
II.	54.54	41.31	20.45	20.86	——	.41
III.	55.40	43.64	22.02	21.62	.40	——
IV.	60.02	40.16	19.38	20.78	——	1.40
V.	45.83	56.22	28.68	27.54	1.14	——
VI.	43.37	50.15	24.77	25.38	——	.61
VII.	44.67	44.02	20.30	23.72	——	3.42
VIII.	22.82	79.68	38.66	41.02	——	2.36
IX.	3.00	67.00	27.00	34.00	——	7.00

This table shows that the range between the hottest and coldest months, is less on the eastern than on the western side of the Mississippi and the Lakes. Look at Sections II, III, and IV. Their ranges are nearly the same, but they differ in mean temperature. That of Section II is 54°.54—that of Section IV, 60°.02; yet their ranges are nearly identical, whereas the lower ought to have much the wider range. Now the former lies east, and the latter west of the Mississippi; which shows that, in going west, the range enlarges. Section III, on the banks of the Mississippi, lies between them, and, with a higher mean temperature than II, has a higher range, the reverse of what would be the case, if the divergence continued uniform in advancing from east to west. The same conclusion results still more obviously, from a comparison of Sections VI and V. The former lies east of the Lakes, the latter west. Its mean temperature is 2°.46 less, which should give it a wider range between the coldest and hottest months; yet the range of the latter is 6° greater. The annual mean temperature of Section VII, including the Lake stations, is intermediate, as to the others; but its range is 6° less than the eastern, and 12° less than the western, showing, in a striking manner, the influence of the Lakes on the temperature of January and July.

SECTION V.

PAIRS OF MONTHS.

The following table presents the average of the mean temperatures of the six pairs of months, beginning with January and July, and traveling through the calendar year. The data are, of course, supplied by the preceding table. The mean annual heat of each station, as resulting from that of the months, is given in the first column; with which the average of each pair of months may be readily compared. To facilitate this comparison, the difference is set down in a separate column, after that for each pair of months, and the excess or defect, compared with mean annual temperature, indicated by the algebraical sign + (plus) or — (minus). At the foot of the table, the mean average is presented.

MEAN TEMPERATURE OF PAIRS OF MONTHS.

No.	PLACES.	Ann. Mean Tem.	Mean of Jan and Jy	Differ-ence.	Mean of Feb & Aug	Differ-ence.	Mn. of Mar. & Sep	Differ-ence.	Mn. of Ap. & Oct.	Differ-ence.	Mn. of My. & Nov.	Differ-ence.	Mn. of Je. & Dec.	Differ-ence.
6	Havana,	78.70	77.14	—1.56	78.90	+0.20	79.39	+0.69	79.25	+0.55	79.57	+0.87	77.95	—0.75
7	Ubajoy,	73.52	74.06	+0.54	75.37	+1.85	73.24	—0.28	73.25	—0.27	72.87	—0.65	72.31	—1.21
8	Key West,	76.63	74.05	—2.58	76.09	—0.54	81.01	+4.38	76.28	—0.35	76.60	—0.03	75.77	—0.86
9	Tampa Bay,	73.38	72.38	—1.00	73.50	+0.12	74.25	+0.87	74.01	+0.63	73.52	+0.14	72.60	—0.78
11	New Orleans,	71.18	70.16	—1.02	71.22	+0.04	74.41	+3.23	72.70	+1.52	69.88	—1.30	68.73	—2.45
15	Pensacola,	68.08	66.96	—1.12	68.44	+0.36	68.55	+0.47	68.55	+0.47	68.38	+0.30	67.58	—1.50
18	Mobile,	70.22	70.63	+0.41	70.40	+0.18	71.19	+0.97	70.09	—0.13	70.02	—0.20	68.97	—1.25
19	Fort Jesup,	68.00	67.92	—0.08	68.52	+0.52	69.46	+1.46	67.55	—0.45	66.87	—1.13	67.06	—0.34
20	Natchez,	67.05	66.79	—0.26	67.68	+0.63	68.42	+1.37	68.43	+1.38	65.75	—1.30	65.22	—1.83
23	Huntsville,	59.38	59.22	—0.16	59.41	+0.03	60.74	+1.36	60.40	+1.02	58.49	—0.89	58.02	—1.36
25	Fort Gibson,	63.20	63.48	+0.28	62.26	—0.94	64.06	+0.86	63.61	+0.41	63.40	+0.20	62.42	—0.78
26	Nashville,	58.44	58.84	+0.40	58.28	—0.16	60.11	+1.70	58.60	+0.16	56.73	—1.71	58.05	—0.39
30	St. Louis,	55.27	55.81	+0.54	55.63	+0.36	56.24	+0.97	56.95	+1.68	53.19	—2.08	53.80	—1.47
31	Portsmouth,	55.53	55.22	—0.31	55.68	+0.16	55.54	+0.01	56.88	+1.35	54.80	—0.73	55.05	—0.41
32	Cincinnati,	53.36	54.48	+1.12	53.20	—0.16	54.20	+0.84	53.82	+0.46	52.52	—0.84	51.97	—1.39
34	Marietta,	52.54	53.12	+0.58	52.42	—0.12	53.39	+0.85	52.36	—0.18	51.85	—0.69	52.11	—0.43
37	Hudson,	47.57	48.05	+0.48	49.45	+1.88	48.35	+0.78	49.30	+1.73	44.40	—3.17	45.85	—1.72
38	Bloomington,	48.51	47.35	—1.16	48.30	—0.21	49.25	+0.47	51.85	+3.34	47.70	—0.81	46.60	—1.91
39	Council Bluffs,	51.34	50.99	—0.35	51.35	+0.01	51.33	—0.01	52.73	+1.41	52.53	+1.21	49.09	—2.25
44	Fredonia,	47.05	49.72	+2.67	48.92	+1.87	48.57	+1.52	48.70	+1.65	44.53	—2.52	41.86	—5.19
46	Prattsburgh,	45.73	46.30	+0.57	44.76	—0.97	46.06	+0.33	46.11	+0.38	43.46	+0.73	44.67	—1.06
54	Fort Crawford,	45.66	46.06	+0.40	46.67	+1.01	46.99	+1.33	44.68	—0.98	46.25	+0.59	43.30	—2.36
56	Rochester,	46.49	47.87	+1.38	45.76	—0.73	46.41	—0.08	46.09	—0.40	46.63	+0.14	46.18	—0.31
60	Lowville,	42.98	42.77	—0.21	42.00	—0.98	44.89	+1.91	43.71	+0.73	42.26	—0.72	42.24	—0.74
62	Pottsdam,	43.84	42.51	—1.33	43.40	—0.44	44.74	+0.90	45.49	+1.65	43.75	—0.09	43.13	—0.71
63	Fort Howard,	44.98	45.19	+0.21	44.51	—0.47	44.40	—0.58	45.39	+0.41	45.71	+0.73	44.69	—0.29
65	Fort Snelling,	45.78	44.52	—1.26	45.32	—0.46	46.26	+0.48	47.63	+1.85	47.73	+1.95	43.21	—2.57
66	Montreal,	44.86	46.77	+1.91	43.90	—0.96	44.33	—0.53	44.68	—0.18	45.94	+1.08	43.54	—1.32
68	Fort Brady,	42.22	42.29	+0.07	43.16	+0.94	41.81	—0.41	42.16	—0.06	43.23	+1.01	40.70	—1.52
78	Winter Island,	6.09	3.45	—2.64	2.08	—4.01	5.05	—1.04	6.01	—0.08	12.42	+6.33	7.51	+1.42
79	Igloolik,	1.72	6.30	+4.58	3.63	+1.71	-0.60	—2.32	2.05	+0.33	-0.26	—1.98	-0.82	+2.54
80	Felix Harbor,	3.59	7.26	+3.67	3.33	—0.26	-3.30	—6.89	3.26	—0.33	5.11	+1.52	5.86	+2.27
	Means,	51.65	51.80		51.67		52.33		52.27		51.37		50.47	
	Variation from Mean Temperature,		+.15		+.02		+.68		+.62		—.28		-1.18	

The results presented in the footing of this table, are not destitute of interest. They show that, of the six pairs of months, but one varies from the mean annual temperature to the extent of a degree; they show also, that the mean temperature of February and August, approaches nearest to the mean temperature of the year; and that the average of June and December departs widest from it. The former are the last winter, and last summer months; the latter are the first summer and first winter months. We likewise see that four of the pairs rise above mean annual heat, two fall below it. Those which present an excess are the four pairs which succeed to the solstices; those which offer a deficiency, are the pairs which precede, and the pair which include, the solstices; the latter showing the greater deficiency of the two — 1°.18. It would be interesting to know whether this is the consequence of inaccurate observations, or in accordance with a law of our climate.

As the mean heat of each pair of months, presents so close an approximation to that of the year, it follows that the mean temperature of the latter may be ascertained, by observing that of the former; but we must bear in mind, that this close approach is made, by the observations of the whole table, which embraces stations in various parts of the Valley, from south to north. In particular portions of it, the coincidence may not be so near. The reader, as he feels an interest in any particular region, may examine it for himself.

It might be supposed that, when we know the mean annual temperature of any particular place, as Nashville, for example, and observe the temperature of a month, as of February, we might predict the heat of August. If, for instance, February were very cold, that August would be very hot; or, if May were unusually hot, November would be correspondingly cool; or, taking seasons, it might be expected, that a rigorous winter would be followed by an ardent summer; a warm spring by a cold autumn, *et vice versa.* But there are two sources of uncertainty in these predictions. *First*, it may be, that the winter and spring should have been compared with the summer and autumn which preceded, instead of following them; and, *second*, we know that the mean heat of different years, at the same place, is not the same, but varies several degrees. It might be, then, that a cold February or April would not be followed by a hot August or October; for the whole year might be one of low temperature. Nevertheless, if any month depart widely from its proper mean heat, there is, *prima facie*, much reason to expect, that its counterpart will vary as much in the opposite direction. This mode of prognosticating may, perhaps, be turned to some account, in deciding beforehand on the probable duration of the prevalence of bilious fever in autumn. Thus, if April and May should be unusually intense, it might be expected that October and November would be so cool, as to give an early termination to autumnal fever; and if June should be violent in its heat throughout, a cold December, and an early setting in of winter, might be expected.

SECTION VI.

DIURNAL AND SUDDEN VARIATIONS.

So far, we have studied the mean temperatures, and annual, seasonal, and monthly extremes of our climates; it remains to indicate the daily regular and irregular variations. This I shall not be able to do by the construction of general tables; for the greater number of published observations do not supply the facts. The mean temperatures of the days, but not of their minima and maxima, are given. The changes we are now contemplating are either regular or irregular, and first, of the former.

I. Regular diurnal Changes.—From the equator to the Arctic Circle, we find, as the law of our climate, a rise of temperature from morning until afternoon. As the lower temperature of the morning, depends on the absence of the sun, leaving the radiation of caloric from the surface of the earth uncompensated by solar influence, we may assume that, in the absence of all disturbing causes, the minimum temperature is immediately before the reappearance of that luminary. Of the disturbing influences it will be proper to mention two or three. Should a wind spring up in the course of the night, or, existing before, change its course, the effects of radiation may be augmented or diminished, so as to give a different morning temperature, from what would have occurred, if the early morning had been calm. Thus, if, in the latter part of the night, a wind from the Gulf of Mexico should reach the central parts of the Valley, the minimum of the morning will be high; or if currents should arrive from the Rocky Mountains, in the west, or what is more common, a south wind should be superseded by a north-east, the minimum may be lower than it would otherwise have been. Again, if clouds should form in the latter part of the night, to throw back upon the surface of the earth a portion of the heat it is radiating, the temperature of the air resting upon it will be kept up. In this manner, fogs which spread abroad from our rivers, ponds, and lakes, give a higher morning temperature, than would otherwise take place. I have said, that the minimum, if no disturbing influences exist, may be assumed to be immediately before the reappearance of the sun; but popular opinion places it at an earlier period. The time can be determined only by observations made every hour, on the state of the thermometer. The places in the Valley where such observations have yet been made, are in the high latitudes of Montreal and Toronto. I have not been able to obtain the latter; but the former have been published by that accurate meteorologist, Mr. McCord, under whose direction they were made for two successive years, at the British military post on the island of St. Helen, opposite Montreal.* Unfortunately, however, they were made at the odd hours in one year, and the even hours in the other, and the two years differed nearly two degrees

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* Report on Meteor. Observ.: Montreal, 1842.

in mean temperature; thus, the relative mean heat of each hour in the latter part of the night, cannot, by these tables, be made out. I may state, however, that in the year in which the even hours were observed, the minimum of those hours was six A. M. for January, February, and March, and four for the other months of the year, except June, when two was lower than four A. M. In the following year, when the odd hours were observed, the coldest was seven A. M. for January, February, and March, and five A. M. for all the other months. When we connect these hours with the times of returning twilight, in the latitude of 45°, we see that they place the minimum of temperature nearly where, by theory, it ought to stand.

Let us turn to the regular maxima. These are never at noon. The heat continues to increase, after the sun has passed the meridian, until by the diminution of its power, from increasing obliquity of its rays, the cooling effects of evaporation and radiation, are equal to the warming solar influence. For a greater or less length of time, these forces may continue *in equilibrio*, giving to the whole period the same temperature; but as the solar force is a diminishing quantity, the heat at length begins to abate. The hour of maximum heat arrives sooner after midday, than that of minimum heat after midnight. It rarely begins before two, or continues after three o'clock. The observations of Mr. McCord, at the even hours, place two o'clock higher than four, in January, February, March, April, May, June, August, and October; in July, September, and November, from one to two tenths of a degree below; in December, 1°.32 below. The observations at the odd hours show three o'clock to be higher than one or five, in all the months of the year. Thus we find two and three to be the hours of maximum heat, in the two successive years, and when we equalize them, by subtracting the difference of the mean temperature of the two years, we have a variation of less than three hundredths of a degree, and are led to the conclusion, that in the latitude of 45°, the temperature of the day is at its maximum from two to three o'clock P. M. Whether this holds good throughout the various latitudes of the Valley, I have not the means of deciding. During several years that I made two daily observations on the thermometer, in Cincinnati, Lat. 39°, I satisfied myself, by repeated inspection of the instrument in the afternoon, that, as a general fact, the maximum of heat is from two to three o'clock. Assuming this as correct, the time from the minimum to the maximum is about nine hours; that from the maximum to the minimum about thirteen, the other two hours of the twenty-four being the duration of the extremes. This seems to indicate a ratio of rise in the thermometer greater than of fall, in the proportion of thirteen to nine; in other words, that the warming is much more rapid than the cooling. But an examination of the McCord tables shows, that after midnight the rate of cooling is greatly diminished, each hour adding but little to the reduction of temperature. Thus the sum of the reduction from eleven to five, 6 hours, was only 3°.03, while the sum of the reduction for the preceding six hours, that is, from five to eleven P. M., was 6°.45. Still, the ascending has, through a part of its course, a considerably greater ratio than the descending scale. At first the rise is slow, and at first the fall is slow; but the latter period is brief compared to the former. It ranges from three to five P. M., while the slow rise is from four or five to eight or nine. From five to eight P. M. the fall is most rapid; this includes sunset and twilight. But the period of most rapid rise does not include the dawn and sunrise, which, throughout the whole year, are about the culminating points; and this discloses to us one reason of the greater salubrity of the morning than the evening twilight. About noon, before the maximum is attained, the ratio of increase abates; but the duration of this period is far shorter than the period of abatement in the ratio of decrease, from eleven or twelve at night, to the maximum of cold before day. Thus the first part of the fall of the thermometer, in the afternoon, is short, compared with the last part of its fall after midnight; but the first part of its rise in the forenoon is long, compared with the last part of its rise, after midday.

Of all the ratios of change in the twenty-four hours, this is greatest, and next to it, is the decrease from five to nine P. M. These, then, are the periods of accelerated change — in the morning, from cold to hot, in the evening, from hot to cold. In one, there is a rapid augmentation of caloric, to act upon the body soon after it has been subjected to the minimum; in the other, a rapid abstraction of caloric, soon after it has been acted on by the maximum. The etiologist cannot fail to appreciate the propriety of investigating the influence of these two periods in the production of disease; but this is not the place to pursue the subject.

On the extent of the daily regular range, from the lowest to the highest heat, in the various parts of the Valley, I cannot speak with certainty. That it has its minimum where the mean temperature has its maximum, in the equatorial belt, is well known. It probably increases with the increasing inequality of day and night, as we go north, but at what ratio has not been determined. Even within the polar circle, it does not cease, for when the day presents twilight only, it has a maximum of heat over the night. In a practical point of view, the interest of the inquiry is limited to the Mexican and St. Lawrence Basins; but although observations have been made at so many places within their limits, but few of them, as published, are applicable to this particular investigation.

From the Huntsville tables, in *MS.*, I have made out, for each month of thirteen years, the average morning and afternoon temperatures, with their differences; from the Picture of Cincinnati, the same for that place, through five years; and from the McCord hourly observations, the same for Montreal, through two years. These are arranged into the following table:

Months.	Huntsville: Mean Temperature 59°.69. Mean Minima.	Huntsville: Mean Maxima.	Huntsville: Difference.	Cincinnati: Mean Temperature 53°.81. Mean Minima.	Cincinnati: Mean Maxima.	Cincinnati: Difference.	Montreal: Mean Temperature 41°.71. Mean Minima.	Montreal: Mean Maxima.	Montreal: Difference.
	°	°	°	°	°	°	°	°	°
January,	35.61	48.06	12.45	24.20	35.56	11.36	10.77	16.74	5.97
February,	36.25	50.31	14.06	28.20	40.64	12.45	13.12	23.43	10.31
March,	43.87	60.61	16.74	37.03	50.91	13.89	18.76	32.40	13.64
April,	56 26	70.35	14.09	48.30	66.86	18.57	31.55	44.53	12.98
May,	59.28	75.10	15.82	52.95	69.69	16.74	47.21	61.66	14.45
June,	67.03	81.90	14.87	60.12	82.20	22.08	57.87	72.05	14.18
July,	69.73	84.47	14.74	65.71	83.31	17.60	61.24	76.66	15.42
August,	68.76	83.72	14.96	64.52	82.02	17.50	61.65	75.68	14.03
September,	62.12	77.64	15.52	58.92	77.66	18.75	52.10	64.29	12.19
October,	52.40	68.36	15.96	47.44	62.72	15.29	41.86	52.88	11.02
November,	41.49	56.14	14.65	35.56	47.94	12.39	29.63	34.58	4.95
December,	35.82	47.39	11.57	29.72	39.36	9.64	17.83	22.66	4.83
Means,	52.38	67.00	14.62	46.05	61.57	15.52	35.30	48.13	11.15

In examining this table, we find, at all the stations, that December is the month in which the difference between the minima and maxima is least; that, at Huntsville, the range is greatest in March, though May comes within less than a degree of being equal; that, at Cincinnati, the greatest range is in the month of June; and at Montreal, in July. These observations, however, are too few to justify any general conclusion. In reference to Cincinnati, it is well known, that June is the month for cholera infantum, often intermingled with croup. The enormous range of 22° between the diurnal extremes, may perhaps explain the prevalence of those maladies, especially the latter. It is worthy of remark, that the difference between the ranges of the lowest and highest months, at Huntsville, is less than at either of the other places. The months of the year come much nearer to a common standard. At Cincinnati, they are more unequal, and at Montreal, more unequal still. The seasonal means are set forth in the following table:

Places.	M. T. of the Year.	Difference between mean Minima and mean Maxima. Year.	Winter.	Spring.	Summer.	Autumn.
	°	°	°	°	°	°
Huntsville,	59.69	14.62	12.69	15.55	14.86	15.38
Cincinnati,	53.81	15.52	11.15	16.40	19.06	15.47
Montreal,	41.71	11.15	7.04	13.69	14.54	9.39

At all the places, the winter range is least; at all, the spring rises over the autumnal range. At Huntsville, the spring exceeds the summer range; but at the other places that of summer is highest.

I have spoken of causes which may depress or exalt the regular minima of diurnal heat; it may be well to devote a paragraph to those which may modify the maxima. A change in the direction of the wind in the course of the forenoon, may have that effect; which change may be the consequence of atmospheric perturbations, at a distant place. A sudden wafting of clouds over a place will, especially in the southern and middle latitudes, keep down the maximum, by intercepting the sun's rays; though in the north, particularly in cold weather, such a canopy, by arresting and throwing back the caloric radiated from the earth, might keep up a higher afternoon temperature. The transition state of vapor may influence the maximum, when it coincides with the proper hour. Thus, in winter, if there should, in the afternoon, be a tendency to snow, the heat may be kept high by the caloric given out in the condensation; and in summer, the formation of a thunder-shower is accompanied by a high temperature, from the same cause. The shower is said to be the consequence of the great heat. Without controverting this, it may be safely affirmed, that until the canopy of condensing vapor intercepts the rays of the sun, the caloric which is liberated augments the intensity of the heat; and hence, while the power of the sun is in itself precisely the same, and the movements of the atmosphere the same on two successive days, the one which has a thunder-storm in the afternoon, will invariably have the higher two-o'clock temperature. If, however, a shower should occur in the forenoon, it *may* lower the maximum.

II. Occasional sudden Changes.—The causes which originate irregular changes of atmospheric temperature, may sometimes coincide in time with the regular, so as to increase the minimum or maximum; but much oftener they break in upon the daily range, and give great extremes of temperature, at other than the ordinary hours. These vicissitudes are, moreover, not confined to a day, but may begin at any time of one day, and continue increasing for twenty-four or forty-eight hours, rarely longer. In reference to health, they are of far deeper interest than the regular diurnal vicissitudes. Like them, they seem to be greater, and they are certainly more frequent, in the middle latitudes, than the lower or higher. The periods of the year in which irregular and violent changes are most frequent, are the latter part of winter and the first half of spring, the beginning of autumn and the beginning of winter. In the south, they occur also in winter; in the north, in summer; in the middle latitudes, in both winter and summer. In those latitudes, the months of October and November are, perhaps, the steadiest in temperature of the whole.

The vicissitudes we are now considering, depend upon, or are connected either with the state of the weather, or the course of the winds, the influence of which, on the *regular* diurnal minima and maxima, have been already pointed out. In regard to the weather, it may be stated in general terms, that (when it is calm) a rise of temperature precedes both snow and rain; and that a fall of temperature as constantly follows those events. This fall is generally proportionate to the amount of water precipitated. But all rains, especially all thunder-showers, are not followed by diminution of temperature; for they sometimes occur in a series, two, three, or more on the same day, with but little intervening reduction of temperature; when, however, the series is ended, a reduction follows. This is truer of the southern, than the middle and northern portions of the Valley. The geographical extent of the changes following on these showers, is often exceedingly limited. Everywhere hail-storms are followed by a lower temperature than rain-showers. The difference is doubtless owing to the absorption of caloric by the hail-stones (often, perhaps, cooled far below the freezing point), as they descend through the atmosphere, and afterward lie dissolving on the earth's surface.

Two winds play a signal part in the production of sudden changes of temperature — the south-west and north-west. Whenever, at any season of the year, except the summer, the south-west wind blows at night, there is an increase of temperature. In the winter it occasions thaws, up to the forty-eighth parallel. In the middle latitudes, a night may be clear and cold; but the next day this wind may spring up, and the following night prove uncomfortably warm. These sudden rises of temperature attract less attention, because they are less uncomfortable, than the opposite extremes. The last depend essentially on what I have called our north-west wind; meaning, however, a wind from any point between north and west. This is the wind which almost invariably follows thunder-showers; and precedes or attends, all sudden reductions of temperature. The coldness of this wind, even in summer, attracted the attention of M. Volney,* who conjectured that it consisted of air, which had descended from a great hight in the atmosphere. On and around the shores of the Gulf of Mexico, the "northers," as the north-west wind is called, often exerts a sudden and most chilling influence, as far south as Havana and Vera Cruz. Even at Key West, its temperature is sometimes very low, and the late Commander Johnston, of our Navy, once saw it, as he informed me, destroy a great many fish in the shoal waters of the Florida reefs, near that island. This will seem the less remarkable, when we recollect the high temperature of the water in which they lived, and think of the reduction it might undergo, when driven in thin sheets upon the strands, by such a wind, continuing for several days and nights. Why it is, that a north-west wind so constantly follows rain and snow, in all parts of the Valley, this is not the place to inquire; but the cause of its low temperature cannot be mistaken. It descends from the Rocky Mountains throughout their whole extent, which may be regarded as the remote source of all sudden depressions of temperature, through the nine milder months of the year; as the Gulf of Mexico is the remote cause of the sudden elevations of temperature, in the other three. The south-west wind generally commences after a calm, and brings with it a humid condition, ending in clouds. On the other hand, the north-west commonly succeeds to the south-west, and brings fair weather. Hence the effects of the opposite changes of temperature on health are not the same,

* View of the Soil and Climate of the United States.

either in kind or in degree. These sudden vicissitudes, which probably abound no where to a greater extent than in the Interior Valley, are, to use a popular phrase, "trying to the constitution," especially in the latter part of autumn, when summer clothing has not yet been laid aside, and in early spring, when it has been prematurely put on. Through both periods, they produce relapses into ague and fever, in regions which generate that disease; accelerate the development of tubercular inflammation of the lungs; and give rise to rheumatism, catarrh, croup, and all other varieties of pulmonary inflammation; concerning which more will be said hereafter. Nevertheless, it cannot be doubted, that the stimulus of change is preferable, in its influences on the constitution, to long-continued and intense heat or cold.

SECTION VII.

MEAN TEMPERATURES DETERMINED BY INDUCTION.

Under this head I propose to give a few examples, which, like the *experimentum crucis*, may determine the accuracy and value of the investigations through which we have passed. In several places, certain deductions have been pronounced to be laws of our climate, and in many tables, ratios have been given, which it was intimated might be employed in determining not merely the annual heat, but its distribution throughout the year. We are now to test the truth of these statements. This I shall do by presenting a calculated thermometrical or thermal year, for a few places where observations have not yet been made, or if made, have not been published. The mean heat is that in the table of calculated mean temperatures, or that resulting from the data by which that table was constructed; and the determination of the months and seasons, was made from the data furnished by the footing of each section of the table of monthly mean heat. In doing this, it was assumed that the difference between the mean annual temperature of the section, and that of the months included in it, might be taken as the difference between the mean annual heat of the place selected for the trial, and the months of that place; then, on ascertaining the difference between the mean temperature of each month, and the annual temperature of the section, that difference was applied to the mean annual heat of the place which had been chosen, and gave that of the months for the calculated year. The extreme ranges were determined by a similar method, from data furnished by the table of annual ranges.

In selecting stations for this purpose, I have fixed on Memphis, in the Mexican Basin, Cleveland in the St. Lawrence Basin, and Pembina, where the forty-ninth parallel cuts Red River of Lake Winnipeg, in the Hudson Basin. The two former are important and flourishing cities, a knowledge of the climates of which cannot be without interest; the latter is at the colony of Lord Selkirk, which seems likely to be much augmented within a few years; for the broad stream of Norwegian, German, and Irish immigration, will probably soon reach the banks of Red River, from its sources with those of the St Peters, to its mouth in Lake Winnipeg. An *a priori* estimate of its climate will, therefore, not be without interest, to those who would desire to know either its agricultural capabilities or its diseases, as far as they depend on climate.

MEMPHIS.

Position.		
N. L.	W. L.	Elevation.
35° 80′	90° 06′	400

Mean Annual Temperature.
61°.85

Extreme Libration.		
Lowest.	Highest.	Range.
—10°	108°	118°

Seasons.			
Winter.	Spring.	Summer.	Autumn.
41°.16	62°.79	81°.97	62°.33

Months.											
Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
° 39.83	° 42.20	° 50.87	° 64.95	° 72.54	° 80.30	° 83.47	° 82.14	° 74.27	° 63.93	° 49.79	° 41.45

CLEVELAND.

Position.		
N. L.	W. L.	Elevation.
41° 31′	81° 46′	640
Mean Annual Temperature.		
51°.02		
Extreme Libration.		
Lowest.	Highest.	Range.
—15°	93°	108°

Seasons.			
Winter.	Spring.	Summer.	Autumn.
31°.94	49°.60	70°.82	54°.61

Months.											
Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
°	°	°	°	°	°	°	°	°	°	°	°
31.19	30.70	37.72	52.20	58.89	64.56	74.72	73.19	66.13	54.04	43.65	33.93

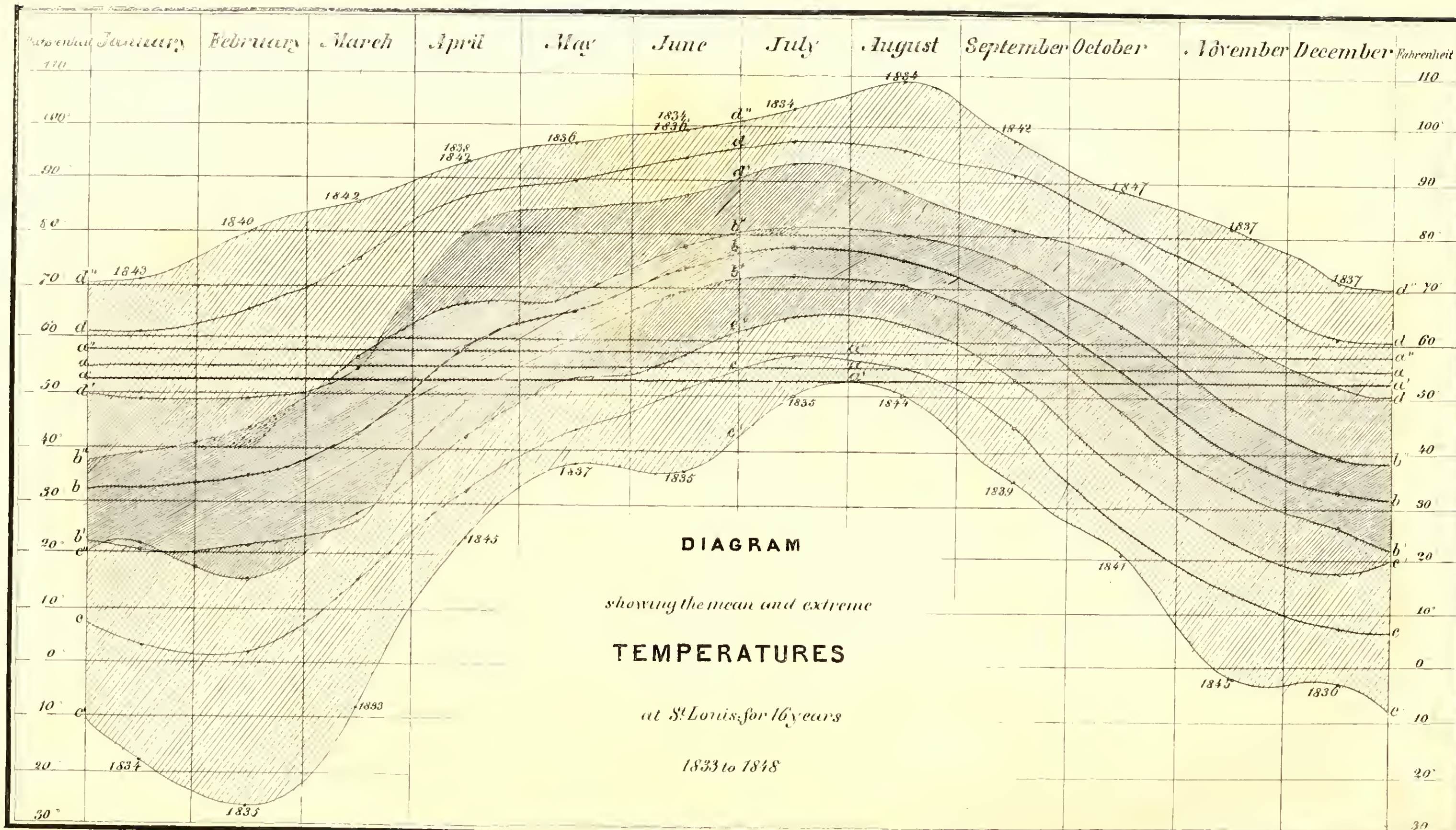
PEMBINA.

Position.		
N. L.	W. L.	Elevation.
49° 00′	98° 00′	800
Mean Annual Temperature.		
38°.60		
Extreme Libration.		
Lowest.	Range.	Highest.
—42°	136°	94°

Seasons.			
Winter.	Spring.	Summer.	Autumn.
11°.30	38°.06	64°.22	39°.59

Months.											
Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
°	°	°	°	°	°	°	°	°	°	°	°
9.91	13.01	24.69	37.16	52.33	63.02	66.13	63.51	52.27	40.17	26.33	10.97

PL.XVIII.



A. Wocher Lith.

Face 519

C.A. Fuller U.S.C. Eng.

SECTION VIII.

TEMPERATURES OF ST. LOUIS AND CINCINNATI, WITH DIAGRAMS.

I. St. Louis.—George Engelmann, M. D., a highly scientific, naturalized German, of St. Louis, has favored me with the unpublished results of a long series of meteorological observations, made at that place, and illustrated with diagrams. The character of the observer, and the central position of St. Louis, in reference to seas, lakes, mountains, and prospective, if not present population, give to these observations a value, which has determined me to print them. Those which relate to temperature, will form a proper conclusion to the present chapter. The notes which follow the tables, and also the diagram, are from Doctor Engelmann; but the latter has been reduced and prepared for the engraver, by Captain Fuller.

TABLE I.

Mean Temperatures of the Months at St. Louis, through Sixteen Years.

Year.	Jan.	Feby.	Mar.	April.	May.	June.	July.	Aug.	Septr.	Octr.	Nov.	Dec.	Whle. year.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1833.	34.00	38.00	44.60	58.55	69.35	72.95	78.57	79.47	68.00	58.00	44.00	36.27	56.81
1834.	20.52	40.55	44.82	58.77	65.30	75.42	81.27	80.60	64.40	53.60	45.95	33.35	55.38
1835.	34.47	21.42	42.12	58.00	65.00	72.50	72.50	71.00	65.00	51.00	40.00	30.00	51.92
1836.	30.87	32.45	38.30	58.55	68.90	74.75	78.57	73.62	67.77	48.42	40.77	29.97	54.58
1837.	29.30	38.52	41.67	49.55	63.50	72.05	78.12	75.42	66.87	58.55	50.00	36.05	54.97
1838.	34.70	20.78	50.51	58.46	60.49	75.71	81.64	80.45	68.63	50.61	34.71	27.42	53.68
1839.	37.17	38.50	45.01	63.10	66.78	70.35	76.36	74.32	64.39	62.79	38.53	30.39	55.64
1840.	26.34	39.75	47.20	61.13	67.28	77.28	76.93	76.04	65.72	54.99	42.68	35.96	55.94
1841.	28.60	32.90	46.14	54.91	66.71	77.43	80.93	77.12	68.06	54.30	46.11	37.15	55.86
1842.	39.72	37.44	56.67	63.05	66.77	72.73	75.85	73.34	71.87	59.00	37.75	35.13	57.44
1843.	36.72	25.35	27.50	55.30	66.84	73.81	79.09	76.80	73.26	51.52	43.17	38.05	53.95
1844.	32.90	41.20	46.50	66.75	67.70	75.56	81.64	77.43	67.95	51.44	44.60	36.58	57.52
1845.	40.55	44.10	45.35	64.30	64.68	74.70	79.75	77.55	70.86	55.31	42.70	27.40	57.27
1846.	38.70	31.45	47.25	58.95	69.30	70.85	81.40	78.60	74.00	56.30	46.35	39.70	57.73
1847.	27.15	36.15	41.38	59.34	63.54	72.02	78.59	74.69	69.09	57.09	45.12	34.76	54.91
1848.	39.39	40.39	44.53	55.21	68.98	72.53	73.73	74.95	64.39	55.83	38.70	32.95	55.13
Mean,	33.19	34.93	44.34	58.99	66.32	73.79	78.43	76.34	68.14	54.92	40.07	33.82	55.57

TABLE II.

Minimum Temperature of each Month.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov'ber.	December.	Whole Year.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1833.			— 6.2	29.7	54.0	56.7	56.6	54.5				+16.2	— 6.2 March 2.
1834.	—18.6	— 1.7	+16.3	24.1	41.0	48.9	56.7	56.7	37.6	23.0	+16.2	+ 2.7	—18.6 January 4.
1835.	+ 9.5	—25.4	+ 8.3			36.5	50.0						—25.4 February 8.
1836.	+ 0.5	— 8.5	+ 7.3	28.6	47.7	56.5	61.2	52.2	45.5	24.0	+16.3	— 1.8	— 8.5 February 1.
1837.	+ 5.0	+16.2	+18.0	25.0	37.6	56.0	62.4	51.1	47.7	28.6	+24.1	+ 7.3	+ 5.0 January 2.
1838.	+ 7.0	— 5.0	+26.0	30.0	38.0	43.0	62.0	64.0	43.0	25.0	+10.0	+ 1.0	— 5.0 February 15.
1839.	+13.0	+ 8.0	+ 5.0	40.0	40.0	43.0	58.0	54.0	35.0	38.0	0.0	+ 5.5	0.0 November 25.
1840.	— 5.5	+10.0	+22.0	38.0	46.5	58.0	55.0	58.0	45.0	23.5	+20.0	+14.0	— 5.5 January 25.
1841.	—11.0	+ 1.0	+26.0	38.0	38.0	52.0	63.0	59.0	47.0	22.0	+20.0	+16.5	—11.0 January 17.
1842.	+20.0	+ 2.0	+28.0	43.0	42.0	45.0	54.0	52.0	44.0	35.0	+ 7.0	+ 4.0	+ 2.0 February 8.
1843.	+ 0.5	— 1.0	+ 7.5	25.0	42.0	46.0	59.0	58.0	53.5	26.0	+24.0	+13.5	— 1.0 February 7.
1844.	+11.0	+17.0	+25.5	38.0	44.0	58.0	65.0	51.0	38.0	28.0	+19.5	+10.0	+10.0 December 17.
1845.	+23.0	+15.5	+19.5	24.0	43.5	56.0	58.0	61.0	47.5	28.0	— 0.5	— 1.0	— 1.0 December 1.
1846.	+21.0	+ 2.0	+20.0	31.0	50.0	53.0	57.0	60.5	53.0	30.0	+19.0	+18.0	+ 2.0 February 26.
1847.	— 0.5	+ 1.5	+12.0	30.0	41.0	54.0	55.0	56.0	45.0	28.0	+21.0	+ 4.5	— 0.5 January 19.
1848.	— 4.0	+11.5	0.0	35.0	43.5	55.0	59.0	58.0	43.0	34.0	+17.0	+ 5.0	— 4.0 January 9.
L. Min.	—18.6	—25.4	— 6.2	24.0	37.6	36.5	50.0	51.0	35.0	22.0	— 0.5	— 1.8	—25.4 Feb. 8, 1835.

TABLE III.

Maximum Temperature of each Month.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Whole Year.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1833.			81.5	92.8	95.0	96.1	101.7	99.5				55.6	101.7 July 29.
1834.	56.7	70.2	77.0	92.7	95.0	99.5	103.3	108.5	97.2	83.7	79.2	56.7	108.5 August 13.
1835.	59.0	61.3	70.2			98.4	98.4						98.4 June 13, July 28.
1836.	50.0	68.0	70.3	89.4	97.2	99.5	98.5	93.9	92.8	87.1	70.3	53.4	99.5 June 9.
1837.	55.5	65.7	68.0	87.0	86.0	87.1	96.2	96.2	92.7	84.9	81.5	72.5	96.2 July 18, 26; Aug. 17, 19.
1838.	64.6	49.4	85.0	93.0	86.0	94.5	101.0	98.5	91.0	86.6	71.0	59.0	101.0 July 30.
1839.	71.0	67.0	78.0	84.0	90.0	93.0	97.0	91.0	86.0	83.0	62.0	49.0	97.0 July 25.
1840.	49.0	81.0	70.0	86.5	88.0	93.0	93.5	91.0	82.0	78.5	67.0	62.0	93.5 July 15.
1841.	60.0	65.0	76.5	81.5	93.0	97.0	100.0	97.0	95.0	77.0	70.0	61.0	100.0 July 11 and 12.
1842.	66.0	67.0	86.0	87.5	88.0	95.0	95.5	95.0	98.0	85.0	78.0	64.0	98.0 September 8.
1843.	71.5	60.0	55.0	93.0	91.0	97.0	98.0	97.0	97.0	83.0	71.0	63.5	98.0 July 17.
1844.	59.0	66.0	79.5	87.0	91.5	94.0	98.0	97.0	94.0	80.0	76.0	64.0	98.0 July 9 and 31.
1845.	65.0	73.0	79.0	91.0	86.0	95.0	97.0	93.0	95.0	79.0	71.0	53.0	97.0 July 13 and 21.
1846.	61.0	51.5	75.0	84.0	89.0	92.0	97.5	93.5	93.0	83.5	69.0	65.0	97.5 July 10.
1847.	66.0	66.0	76.0	84.0	87.0	88.0	94.0	89.5	92.0	88.5	77.0	67.0	94.0 July 15, 16, 17, and 18.
1848.	64.0	73.0	78.0	82.0	91.0	90.5	95.0	94.5	86.5	77.5	63.0	66.0	95.0 July 13.
H. Max.	71.5	81.0	86.0	93.0	97.2	99.5	103.3	108.5	98.0	88.5	81.5	72.5	108.5 August 13, 1834.

TABLE IV.

Monthly Range of Temperature.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec'mber.	Whole Yr.
	°	°	°	°	°	°	°	°	°	°	°	°	
1833.			87.7	63.1	41.0	39.4	45.1	45.0				39.4	108.9
1834.	75.3	71.9	60.7	68.6	54.0	50.6	46.6	51.8	59.6	60.7	63.0	54.0	127.1
1835.	49.5	86.5	61.9			61.9	48.4						123.8
1836.	49.5	76.5	63.0	60.8	49.5	43.0	37.3	41.7	47.3	63.1	54.0	55.2	108.0
1837.	50.5	49.5	50.0	62.0	48.4	31.1	33.8	45.1	45.0	56.3	57.4	65.2	91.2
1838.	57.6	54.4	59.0	63.0	48.0	51.5	39.0	33.6	48.0	61.6	61.0	58.0	106.0
1839.	58.0	59.0	73.0	44.0	50.0	50.0	39.0	37.0	51.0	45.0	62.0	43.5	97.0
1840.	54.5	71.0	48.0	48.5	41.5	35.0	38.5	33.0	37.0	55.0	47.0	48.0	99.0
1841.	71.0	64.0	50.5	43.5	55.0	45.0	37.0	38.0	47.5	55.0	50.0	44.5	111.0
1842.	46.0	65.0	58.0	44.5	46.0	50.0	41.5	43.0	54.0	50.0	71.0	60.0	96.0
1843.	71.0	61.0	47.5	68.0	49.0	51.0	39.0	39.0	43.5	57.0	47.0	50.0	99.0
1844.	48.0	49.0	54.0	49.0	47.5	36.0	33.0	46.0	56.0	52.0	56.5	54.0	88.0
1845.	42.0	57.5	59.5	67.0	42.5	39.0	39.0	32.0	47.5	51.0	71.5	54.0	98.5
1846.	40.0	49.5	55.0	53.0	49.0	39.0	40.5	33.0	40.0	53.5	50.0	47.0	95.5
1847.	66.5	64.5	64.0	54.0	46.0	34.0	39.0	33.5	47.0	60.0	56.0	62.5	94.5
1848.	68.0	61.5	78.0	47.0	47.5	35.5	36.0	36.5	43.5	43.5	46.0	61.0	99.0
Ext. rge.	90.1	105.4	92.2	69.0	59.6	63.0	53.3	57.5	63.0	66.5	82.0	74.3	133.9

TABLE V.

GREATEST CHANGE OF TEMPERATURE WITHIN TWENTY-FOUR HOURS, IN EACH MONTH.

Years.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
	°	°	°	°	°	°	°	°	°	°	°	°	
1833.			52.0	37.0	31.5*	31.5*	29.0*					32.0	52.0 March 2–3.
1834.	41.5	40.5	48.0	41.5*	36.0	37.0*	36.0*	37.0*	47.0	38.0*	32.5*	54.0	54.0 December 7–8.
1835.	32.5*	40.5	39.0			36.0	30.5*						
1836.	31.5	36.0*	44.0	44.0	35.5*	31.5	28.0*	27.0*	31.5*	42.5	29.0*	48.5	48.5 December 20–21.
1837.	28.0	31.5	33.0	38.0	40.0	19.0	26.0	36.0	27.0*	31.0	29.0*	31.0	40.0 April 30—May 1.
1838.	33.0	31.0	44.0	35.0*	36.0	31.0*	28.0	29.5	31.0*	39.0*	26.0*	35.0*	44.0 March 20–21.
1839.	36.5	35.0*	54.0	36.0	27.0*	32.0	26.0*	26.0	31.0	32.0	28.0	24.5	54.0 March 1–2.
1840.	35.0	33.0*	29.0	41.0	22.0*	21.0	21.5	21.0	27.0*	34.0	32.0	25.0	37.5 April 25–26.
1841.	36.0	31.0*	30.0	30.0	30.0*	24.0*	25.0	24.0*	33.5	29.0*	35.0	25.0	36.0 January 15–16.
1842.	34.5	36.0	34.0	30.0*	29.0*	43.0	27.5	29.0*	31.0*	36.0*	41.0	31.0	43.0 June 10–11.
1843.	46.0	47.5	43.5	34.0*	31.0	28.5*	29.5	26.5	25.0*	33.0*	22.0*	32.5*	47.5 February 26–27.
1844.	25.0	30.0*	37.5*	29.0*	28.0	26.5*	24.5	31.0	43.5	32.0	28.5*	32.0	43.5 September 20–21.
1845.	33.5	36 5*	35.0*	35.0*	30.5	33.0*	25.5	23.5	28.5*	36.0	43.0	32.5	43.0 November 22–23.
1846.	27.0	27.0*	35.0*	38.0	26.5*	23.0	32.0	24.0	23.5*	34.0*	26.5*	26.0	38.0 April 14–15.
1847.	56.0	32.0*	37.0*	36.0*	30.0	27. 5	26.0*	32 0	31.5*	29.0*	28.0	24.0*	56·0 January, 15–16.
1848.	40.0	38.0	36.0	45.5	27.0	31.0*	27.0	24.0	27.5*	36.5*	32.0	37.0	45.5 April 23–24.
Grt. ch.	56.0	47.5	54.0	45.5	40.0	43.0	36.0*	37.0*	47.0	42.5	43.0	48.5	56.0 January 15–16, 1847.

EXPLANATORY NOTES, BY DR. ENGELMANN.

1. The observations were made, in St. Louis, with the exception of those of the first three years, 1833 to 1835, which were made within twenty miles of the city. In those years, the temperature certainly reached its extremes; and we have not experienced, since that time, such cold winters as those of 1833–4 and 1834–5, nor so hot a summer as in 1834, nor so cool an one as in 1835, of which it has been said, though with some exaggeration, that it froze in every month of the year! But the extremes, especially of cold, appear to be greater in the country than in the city, and it may be well to bear that in mind, in examining these tables.

2. Table I gives the mean temperatures. Up to 1844, the mean of each month has been calculated from the mean between the lowest and highest temperature of each day, and from 1845 to 1848 from the mean of the observations made at sunrise and at three o'clock, P. M., which is believed to lead pretty much to the same result.

3. Table II gives the minima. It will be observed that in twelve of the sixteen years, the thermometer fell to, or below, zero, and the monthly tables evince that it stood at or below zero in

1833,	on 1 day in March,	1 day.
1834,	" 7 days in January and 1 in February,	8 days.
1835,	" 7 days in February,	7 "
1836,	" 1 day in February and 2 in December,	3 "
1837,	it never came down to zero.	
1838,	" 5 days in February,	5 "
1839,	" 1 day in November,	1 "
1840,	" 1 day in January,	1 "
1841,	" 2 days in January,	2 "
1842,	not below zero.	
1843,	" 1 day in February,	1 "
1844,	not below zero.	
1845,	" 1 day in November and 1 in December,	2 "
1846,	" not below zero.	
1847,	" 1 day in January,	1 "
1848,	" 1 day in January,	1 "
In 16 years, the mercury stood at or below zero, on		33 days.

4. Table III gives the maxima. It appears that in April, the thermometer rose above 90°, in five of the sixteen years; in May, in eight years; in June, in all except two; in July, in every one; in August, in all except one; in September, in all except three; but never in the other six months. Only in July or August did it reach to 100° or above it; and that but in four of the sixteen years — 1833, 1834, 1838, and 1841. In three years, 1840, 1847, and 1848, the highest temperature never surpassed 95°.

The temperature rose to 100° or above it, in

1833,	3 days in July,	3 days.
1834,	8 " in " and 6 in August,	14 "
1838,	3 " in ".	3 "
1841,	2 " in "	2 "
or in 16 years, only on		22 days.

5. Table IV gives the range of the monthly and annual temperature. It will be seen that, contrary to common opinion, the changes are by far the greatest in the winter months, especially from January to March, and more in February, and next to that, in March, than in any other month. The lowest range is observed in July, where it never has exceeded 48°.4, but is on an average only 39°.5.

Though the mean temperature of February is a little higher than that of January, the lowest temperatures are considerably lower in February, and so far, the popular opinion is not without foundation, which makes February the coldest month in the year.

6. Table V records the greatest changes of temperature which have occurred in every month in sixteen years.

The greatest changes take place from noon or afternoon of one day to sunrise next morning—the temperature falling. Great rises occur from sunrise to noon or afternoon of the same day; but they are generally not so excessive, though perhaps equally deleterious to the human system. The rises take place in eight to ten hours; they are indicated in the table by a *; the falls occur mostly within thirteen to fifteen hours, and are not thus indicated.

The greatest changes occur in the winter months, in spring and fall; in one instance, only, in those sixteen years, has the temperature changed 40° or more in May and in June; in September, December, January, February, and March, the change reached, once or oftener, 45° or more. In December, January, and March, it reached to 50° or more. But on the average, greater changes have occurred in March and April, than in any other month, and smaller changes in November and December, than in either October, January, or February.

The temperature of the years 1833, 1834, and 1835, has not been so regularly observed, and that, too, in the country, near St. Louis, where the changes are generally more violent than in the city.

II. Cincinnati. — Having submitted the tables of Doctor Engelmann, to Joseph Ray, M. D., Professor of Mathematics and Natural Philosophy in Woodward College, a meteorologist of most reliable scientific accuracy, he has at my request, obligingly furnished me with corresponding tables for Cincinnati; and, also, a diagram, which may be compared with that of Doctor Engelmann. St. Louis is half a degree south of Cincinnati, and five degrees, forty-seven minutes, further west. Its elevation above the sea, is about one hundred feet less than that of the latter city. The Mississippi, at St. Louis, flows nearly from north to south — the Ohio, at Cincinnati, from east to west. No hills surround St. Louis — those around Cincinnati are about two hundred and fifty feet above the upper plain — that on which the observations of Professor Ray were made. An attentive examination of the results, obtained by two enlightened observers, so nearly in the same latitude and elevation, but separated by nearly six degrees of longitude, cannot fail to prove instructive.

TABLE I.

Mean Temperature of Cincinnati, for Fourteen Years.

Years.	January.	Feby.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Whole Year.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1835.	34.6	24.5	40.1	50.5	65.3	71.2	71.7	69.1	59.1	55.8	43.3	31.4	51.3
1836.	30.6	28.8	36.1	55.6	65.8	70.4	75.8	71.6	69.3	46.2	38.7	30.6	51.6
1837.	30.1	36.6	41.8	48.3	62.5	70.1	75.3	72.4	64.9	55.8	48.1	35.5	53.5
1838.	36.4	20.9	48.4	50.5	56.7	73.1	79.2	77.7	66.3	50.6	39.0	28.2	52.2
1839.	38.0	37.0	44.9	60.2	66.0	69.5	76.2	73.5	61.1	60.3	37.3	30.6	54.5
1840.	25.7	42.0	47.7	57.4	63.2	70.8	75.4	74.7	61.8	54.3	40.9	32.4	53.9
1841.	32.0	32.5	44.7	51.2	62.1	75.1	79.1	76.4	67.8	51.2	44.2	36.3	54.4
1842.	36.7	36.4	52.4	57.7	60.8	69.0	75.6	71.4	66.6	52.2	35.1	33.8	54.0
1843.	35.8	26.6	28.8	51.3	62.8	70.4	73.8	70.3	69.3	47.7	40.6	36.2	51.1
1844.	31.7	37.4	44.4	64.1	66.8	71.6	78.5	72.6	65.7	49.5	44.2	36.3	55.2
1845.	37.9	40.1	44.5	59.9	61.6	72.6	73.4	73.0	64.1	50.2	40.3	24.8	53.5
1846.	35.2	31.5	44.2	57.1	67.0	68.2	75.9	76.4	70.7	52.8	45.7	39.8	55.4
1847.	30.8	36.8	40.2	55.7	62.7	69.2	74.4	70.5	64.1	53.2	44.9	34.3	53.1
1848.	36.7	36.9	42.3	53.7	66.5	71.8	73.8	74.6	62.2	54.0	39.8	41.1	54.4
Mean of 14 ys.	33.7	33.4	42.9	55.2	63.6	70.9	75.6	73.2	65.2	52.4	41.6	33.7	53.4

TABLE II.

MINIMUM TEMPERATURE OF EACH MONTH IN FOURTEEN YEARS, AT CINCINNATI.

Years.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Whole Year.	
	°	°	°	°	°	°	°	°	°	°	°	°	°	
1835.	3	—17	1	21	40	45	48	46	33	29	3	9	—17	February 8.
1836.	0	— 7	— 4	25	38	52	55	48	40	27	15	3	— 7	February 3.
1837.	5	8	20	26	39	52	57	52	42	26	22	7	+ 5	January 3.
1838.	8	—10	11	28	36	53	59	62	39	30	14	— 4	—10	February 22.
1839.	13	5	2	32	36	46	54	47	31	32	2	8	+ 2	March 4.
1840.	— 1	0	21	27	42	47	50	57	41	19	18	7	— 1	January 2, & 19.
1841.	— 7	4	18	30	37	53	59	59	42	25	25	18	— 7	January 18.
1842.	9	— 5	25	27	36	45	56	53	40	27	8	0	— 5	February 17.
1843.	2	— 2	1	26	41	38	50	53	48	19	22	15	— 2	February 7, & 16.
1844.	— 1	15	20	28	45	54	65	56	38	26	15	8	— 1	January 29.
1845.	19	8	18	20	34	51	49	50	40	25	11	— 6	— 6	December 20.
1846.	10	0	20	27	43	46	57	64	44	28	15	19	0	February 26.
1847.	— 3	5	14	26	36	47	54	52	38	27	19	2	— 3	January 8.
1848.	— 4	17	5	31	40	50	58	61	40	36	25	24	— 4	January 10.
Lst. Min.	— 7	—17	— 4	20	34	38	48	46	31	19	2	— 6	—17	

TABLE III.

MAXIMUM TEMPERATURE OF EACH MONTH IN FOURTEEN YEARS, AT CINCINNATI.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Whole Year.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1835.	66	56	70	83	91	95	93	89	86	82	76	63	95 June 13.
1836.	61	62	71	91	89	95	99	95	93	80	68	55	99 July 23.
1837.	53	66	73	89	95	95	95	94	90	80	75	73	95 July 15.
1838.	69	51	85	85	87	93	97	100	91	84	65	54	100 August 9.
1839.	66	70	79	83	94	94	96	95	88	88	61	48	96 July 25.
1840.	55	75	75	91	89	93	96	93	85	82	71	58	96 July 16.
1841.	54	58	83	82	93	99	98	96	93	76	72	64	99 June 12.
1842.	65	69	85	90	88	95	92	88	94	84	77	69	95 June 22.
1843.	67	58	59	88	93	97	98	92	92	77	68	60	97 July 1.
1844.	56	70	72	89	89	90	94	93	89	76	75	64	94 July 6 & 14.
1845.	62	70	77	93	91	94	95	95	86	76	68	51	95 July 21.
1846.	67	55	69	88	91	91	96	95	92	81	73	66	96 July 10.
1847.	67	60	72	86	88	92	92	90	89	83	75	60	92 July 18.
1848.	60	60	86	84	90	91	90	92	86	75	59	73	92 Aug. 14.
Hst. Max.	69	75	86	93	95	99	99	100	94	88	77	73	

TABLE IV.

MONTHLY RANGE OF TEMPERATURE AT CINCINNATI, IN FOURTEEN YEARS.

Years.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Whole Year.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1835.	63	73	69	62	51	50	45	43	53	53	73	54	112
1836.	60	69	75	66	51	43	44	47	53	53	53	52	106
1837.	48	58	53	63	56	43	38	42	48	54	53	66	90
1838.	61	61	74	57	51	40	38	38	52	54	51	58	110
1839.	53	65	77	51	58	48	42	48	57	56	59	40	94
1840.	56	75	54	64	47	46	46	36	44	63	53	51	97
1841.	61	54	65	52	56	46	39	37	51	51	47	46	106
1842.	56	74	60	63	52	50	36	35	54	57	69	69	100
1843.	65	60	58	62	52	59	48	39	44	58	46	45	99
1844.	57	55	52	61	44	36	29	37	51	50	60	56	91
1845.	43	62	59	73	57	43	46	42	46	51	57	57	101
1846.	57	55	49	61	48	45	39	28	48	53	58	47	96
1847.	70	55	58	60	52	45	38	38	51	56	56	58	95
1848.	64	43	81	53	50	41	32	31	46	59	34	49	96
Ex.Ra.	70	75	77	73	58	59	48	48	57	63	73	69	

TABLE V.

GREATEST CHANGE OF TEMPERATURE WITHIN 24 HOURS, IN EACH MONTH, FOR 14 YEARS.

Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Whole Year.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1835.	33	37	37	37	35	31	32	30	33	31	30	28	37
1836.	27	35	32	43	46	33	38	28	30	32	36	30	46
1837.	27	25	32	40	42	31	30	35	22	31	32	31	42
1838.	29	31	30	37	38	31	28	28	37	35	34	36	38
1839.	25	35	31	38	35	35	39	33	35	40	29	19	40
1840.	31	38	41	38	33	30	25	27	32	35	40	33	41
1841.	21	30	30	37	36	33	30	28	30	35	31	21	37
1842.	35	30	43	43	43	34	28	29	34	41	44	34	44
1843.	31	31	32	34	36	38	34	32	29	38	28	26	38
1844.	28	31	33	37	33	28	25	26	32	31	35	27	37
1845.	32	38	39	43	42	32	30	33	31	39	35	32	43
1846.	29	29	35	40	32	30	24	23	27	33	32	25	40
1847.	22	27	33	42	38	30	25	25	29	36	29	30	42
1848.	28	27	40	40	38	30	23	20	27	29	22	29	40
Gr. ch.	35	38	43	43	46	38	39	35	37	41	44	36	

III. In comparing these two sets of observations, we must add to the mean temperature of Cincinnati, for its higher latitude, 0°.85, and for its greater elevation 0°.25, thus raising it from 53°.40 to 54°.50, which subtracted from 55°.57, the temperature of St. Louis, gives a difference of 1°.07. To infer from this that the mean annual heat of the meridian of Cincinnati, is less than that of St. Louis, 5° 47′ of longitude, further west (the latitudes and elevations being equalized), would, I suppose, be inadmissible; as slight variations in the instruments, their adjustment, or the times of observing them, might produce the result. The probability of this is increased, by comparing St. Louis with Portsmouth, which lies 7° 20′ of longitude east of St. Louis, and yet differs from it in mean temperature, but two-thirds of a degree, the proper corrections for latitude and elevation being made.

In comparing the months, subjected to the same corrections, we find that November, December, and January are colder, while February and March are nearly the same, at St. Louis as at Cincinnati, which shows a more rigorous and protracted winter. This, however, is compensated by the heat of April, which rises above that of the same month in Cincinnati 2°.69; an excess corresponding to the greater cold of St. Louis in November, which is 2°.63. Hence the transition from winter to summer, and from summer to winter, through the months of April and November, is more violent in the meridian of St. Louis than of Cincinnati. When January and July are compared, we find the former month, at St. Louis, 1°.61 below that of Cincinnati, while the latter month is 1°.73 above, making the range of mean heat, between the coldest and hottest month, 3°.34 greater at St. Louis than Cincinnati.

When we examine the tables of minima, we find the thermometer below zero, in the months of November, December, January, February, and March, at St. Louis, but never below in the first of these months at Cincinnati. The lowest minimum at the former was 9° below that of the latter.

The tables of maxima give us a rise above 90°, from April to September inclusive, at St. Louis, and the same at Cincinnati; but the average rise above 90° for that period, in the former city, is 10°; in the latter, 6°. The greatest heat observed at the two places, was for St. Louis, 108°.5; for Cincinnati, the correction being made, 101°.5. In comparing their extreme annual ranges, that of St. Louis rises 15° above that of Cincinnati.

Compared by their greatest changes of temperature in twenty-four hours, we find those of St. Louis to predominate in January, February, March, April, June, September, October, and December; to be nearly equal in April, October, and November; and in May only, to be considerably greater in Cincinnati. The average of the excess of St. Louis over Cincinnati, for eight months, is 9°; of the former over the latter, for four months, not quite 4°. The greatest change observed at St. Louis, in twenty-four hours, was 56°, at Cincinnati, 46°.

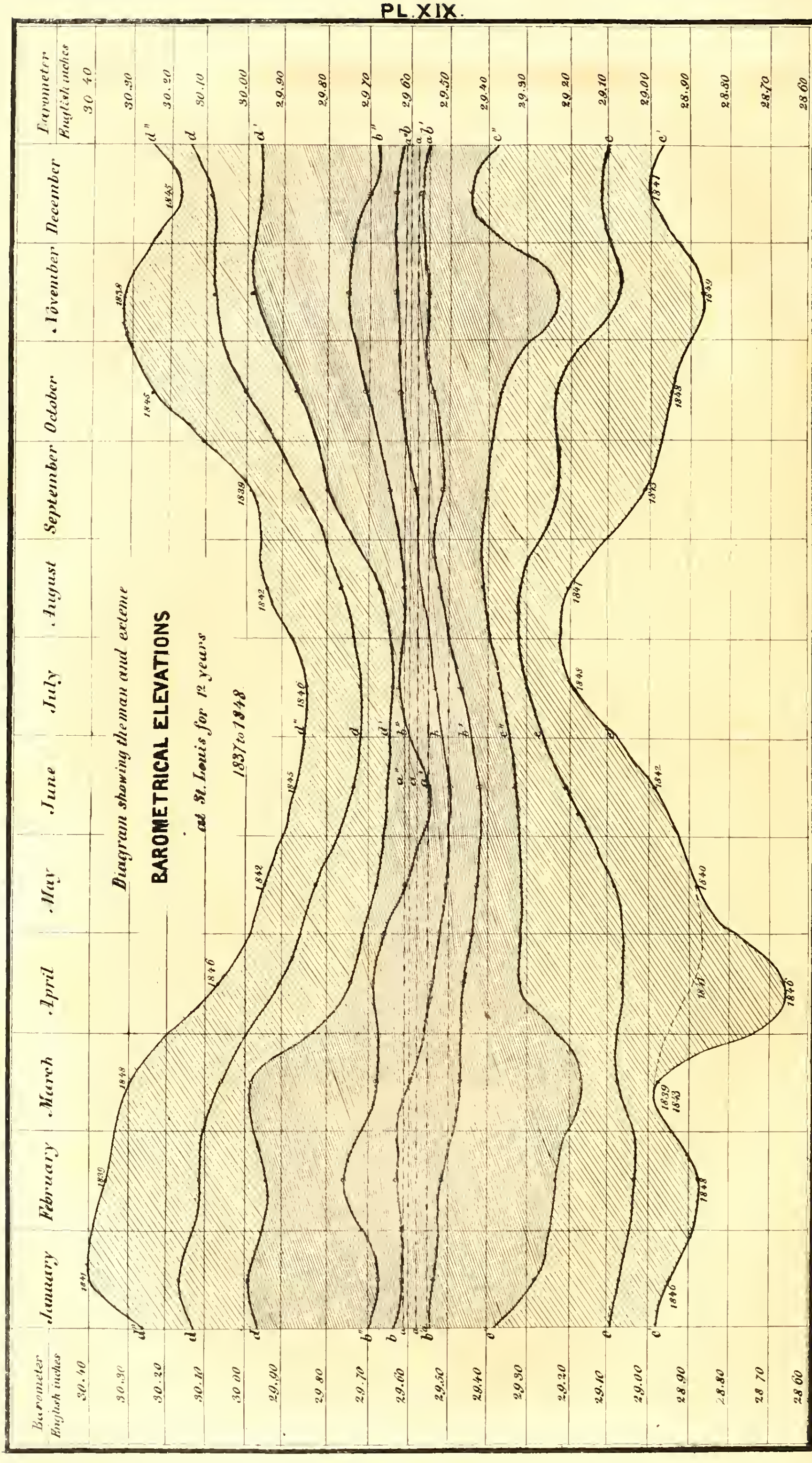
Thus, it appears, that while the two cities, which have been compared, vary but little more than one degree in mean temperature (allowance being made for their difference in latitude and elevation), the extremes of every kind are decidedly more violent at St. Louis than Cincinnati. Coinciding with this result, we have in the table, *page* 47, the annual range at Portsmouth 106°, Cincinnati 117°, St. Louis 134°, Fort Leavenworth 135°; which stations lie nearly in the same latitude, and vary in mean temperature but a few degrees; while the first is in longitude 82° 56′, and the last 94° 94′, more than 12° further west, through which the annual range increases. It seems, then, to be a law of our climate, already more than once hinted at, that about the thirty-ninth parallel, the oscillations of the thermometer become more sudden and extreme as we advance from east to west, and this is probably true of the whole plain, or level country, between the Lakes and the Gulf of Mexico.

SECTION IX.

CURVE OF MEAN TEMPERATURE OF THE INTERIOR VALLEY.

The mean of all the means of the general table of annual temperatures, is within a fraction of 50°, which may, therefore, be taken in the present stage of observation, as the curve of mean temperature for the entire Valley. In referring to the places, whose observed mean temperatures vary not more than a degree from 50°, we find them included between the forty-first and forty-second parallels of latitude. Of the whole, Fort Armstrong, at Rock Island, Illinois, and Bloomington, Iowa, both on the Mississippi River, in N. Lat. 41° 31′ and 41° 26′, approach nearest to the isothermal curve of 50°. The other places, lying between the forty-first and forty-second degrees, at which observations have been made, are Council Bluffs, on the Missouri River, Fort Dearborn, at Chicago, and Hudson, south of the middle of Lake Erie. The first would carry it a little above the forty-second degree, the last two below the forty-first. The Steubenville observations, N. Lat. 40° 25′, place it a few minutes below that parallel; those of Marietta seven minutes above. The mean between that place and Hudson, which lie in the same longitude, would fix it at 41° 22′. On the whole, we may, in the present state of our knowledge, say, that the isothermal curve of mean temperature for the whole Valley meanders, from the Alleghany River to the Missouri River (the elevation being from six hundred to one thousand two hundred feet), between the forty-first and forty-second parallels; but seems, from the observations at Council Bluffs, to rise highest in the west. The western extremity of Lake Erie, and the southern end of Lake Michigan, dip into this zone; which, likewise, includes the northern part of Ohio and Indiana, cuts through the northern portion of West Pennsylvania, and of Illinois, and traverses the southern half of Iowa. To the north of this zone lies the colder, to the south, the warmer climatic half of the Valley. It is worthy of remark, that this zone ranges nearly equidistant between the Gulf of Mexico and Hudson Bay, and also between the band of Equatorial Heat and the Pole of Cold.

PL. XIX.



Lith by A. Wooner

Face 531.

C. A. Fuller U.S.C. Eng. del.

CHAPTER III.

ATMOSPHERIC PRESSURE OF THE INTERIOR VALLEY.

SECTION I.

INTRODUCTION.

I. As the variations in the weight or pressure of the atmosphere, at the same place, depend, directly or indirectly, on the temperature of the air, their study naturally follows that in which we have been engaged; and, in turn, prepares us for the study of our winds and weather, which are intimately connected with barometric oscillations.

II. The difficulties and deficiencies which we meet, in this department of our meteorology, are great; for, although a large proportion of the meteorologists, whose thermometrical observations were quoted in the last chapter, have kept barometrical registers, but few have made allowance for the effect of variations of temperature, on the mercurial column, or for the influence on its hight, of the capillary attraction of the tube; whereby their records are not a true expression of the weight of the atmosphere. From the former cause especially, the errors must necessarily be very great in a country like ours, where the mean heat of winter and summer differs so widely; and that of the same month or season in the south, as at New Orleans, varies so greatly from that in the north, as at Quebec; while both are at the level of the sea. Thus the mean temperature of the month of October, is 28° higher in the former, than the latter city; and if the true atmospheric pressure at the two stations were the same, it would *seem* to be greater in the south, to the extent that the barometric column would be elongated by 28° of additional temperature. In most of the meteorological tables which are before me, there is no record of the state of the thermometer attached to the barometer; and, even where such a register is given, the data for calculating the effect of capillarity are wanting; I have determined, therefore, to depend chiefly on the observations made at St. Louis, Cincinnati, Hudson, Toronto, and Montreal.

SECTION II.

BAROMETRIC OBSERVATIONS AT ST. LOUIS, MISSOURI.

The thermometrical tables of Dr. Englemann were given in the eighth section of the last chapter. The same gentleman has kindly furnished me with the unpublished results of his observations on the barometer, through twelve years of the same period, carefully arranged by himself, and has added to the tables an instructive diagram. With these we shall begin.

TABLE I.

MEAN BAROMETRICAL ELEVATION AT ST. LOUIS, FOR TWELVE YEARS. ALTITUDE 450 FEET ABOVE THE SEA.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec'mber.	Whole Yr.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1837.	29.538	29.608	29.653	29.511	29.457	29.431	29.528	29.537	29.591	29.608	29.555	29.644	29.555
1838.	.668	.696	.684	.471	.498	.464	.552	.605	.650	.628	.760	.682	.613
1839.	.583	.760	.611	.484	.441	.495	.537	.596	.589	.628	.648	.565	.578
1840.	.680	.621	.473	.568	.450	.498	.581	.551	.629	.577	.590	.712	.578
1841.	.654	.650	.547	.577	.566	.461	.567	.593	.516	.622	.563	.612	.577
1842.	.608	.558	.614	.503	.528	.481	.624	.608	.615	.618	.636	.686	.590
1843.	.602	.597	.626	.514	.511	.489	.607	.598	.558	.600	.662	.671	.586
1844.	.577	.670	.596	.587	.507	.511	.507	.531	.656	.644	.603	.573	.580
1845.	.599	.560	.642	.502	.620	.553	.496	.543	.543	.709	.608	.706	.590
1846.	.568	.619	.526	.500	.420	.520	.520	.525	.555	.667	.600	.580	.550
1847.	.665	.523	.628	.574	.478	.520	.530	.568	.533	.565	.625	.648	.571
1848.	.650	.563	.572	.685	.434	.512	.487	.547	.572	.557	.633	.552	.564
M. of 12Y	29.616	29.618	29.598	29.540	29.493	29.495	29.544	29.567	29.584	29.619	29.623	29.636	29.578

QUARTERLY MEANS.

Winter, 29.617	Spring, 29.543	Summer, 29.535	Autumn, 29.609.

TABLE II.

MINIMUM BAROMETRICAL ELEVATION IN EVERY MONTH FOR TWELVE YEARS, AT ST. LOUIS.

Years.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Minimum of the whole Year.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1837.	29.080	28.950	29.000	28.950	29.140	29.140	29.300	29.220	29.290	29.300	29.160	29.060	28.950 February 22; April 7.
1838.	28.960	29.240	.170	29.010	.230	.310	.280	.420	.270	.160	.190	.040	.960 January 17.
1839.	29.110	29.080	28.990	.080	.040	.200	.340	.350	.070	.390	28.880	.050	.880 November 4.
1840.	.190	28.890	29.060	.100	28.890	.170	.330	.330	.380	.240	29.020	.290	.890 February 9; May 3.
1841.	.230	29.170	.080	28.900	29.320	.240	.360	.370	.190	.200	28.950	.000	.900 April 29.
1842.	.050	28.960	.060	29.240	28.990	28.990	.290	.300	.300	.280	29.040	.170	.960 February 29.
1843.	.050	29.060	28.990	.110	29.040	29.220	.380	.380	.020	.230	28.990	.190	.990 March 27.
1844.	28.980	29.190	29.110	.140	.100	.270	.330	.320	.410	.270	29.230	.020	.980 January 12.
1845.	29.275	29.005	.110	.110	.220	.340	.255	.400	.195	.320	.215	.445	29.005 February 14.
1846.	28.955	28.960	.040	28640	.165	.185	.305	.280	.260	.315	.175	.055	28.640 April 28.
1847.	.960	29.020	.170	29.115	.120	.260	.390	.235	.250	.255	.025	.215	.960 January 4.
1848.	29.055	28.870	.030	.320	28.945	.190	.190	.315	.135	28.955	.115	28.990	.870 February 19.
L. Min.	28.955	28.870	28.990	28.640	28.890	28.990	29.190	29.220	29.020	28.955	28.880	28.990	28.640 April 28, 1846.

TABLE III.

MAXIMUM BAROMETRICAL ELEVATION IN EVERY MONTH, FOR TWELVE YEARS, AT ST. LOUIS.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Maximum of the whole Year.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1837.	29.980	29.990	29.990	29.850	29.810	29.820	29.680	29.780	29.850	29.980	30.010	29.960	30.010 November 16.
1838.	30.150	30.050	30.030	.840	.780	.670	.780	.750	.860	.970	.310	30.120	.310 November 29.
1839.	.120	.360	.150	.750	.810	.700	.730	.830	.980	.950	.200	.040	.360 February 6.
1840.	.190	.130	.030	.850	.830	.780	.810	.780	.860	30.010	29.990	.090	.190 January 25.
1841.	.400	.140	.090	.960	.810	.650	.740	.840	.820	.050	29.980	.010	.400 January 18.
1842.	.090	.130	.030	.870	.940	.810	.820	.940	.830	29.870	30.150	.170	.170 December 26.
1843.	.060	.060	.010	.840	.800	.710	.820	.740	.840	30.030	.010	.160	.160 December 12.
1844.	.110	29.960	.070	.850	.840	.710	.650	.730	.930	29.940	.050	.110	.110 December 8.
1845.	.190	30.080	.120	.055	.890	.870	.685	.840	.855	30.245	.090	.170	.245 October 15.
1846.	.210	.345	29.985	30.065	.760	.845	.850	.675	.800	29.940	29.980	.120	.345 February 26.
1847.	.290	29.945	30.015	29.985	.860	.650	.675	.735	.815	30.160	30.120	.070	.290 January 21.
1848.	.150	.995	.305	30.050	.695	.785	.680	.805	.895	29.980	29.995	.020	.305 March 5.
H. Max	30.400	30.360	30.305	30.065	29.940	29.870	29.850	29.940	29.980	30.245	30.310	30.170	30.400 January 18, 1841.

TABLE IV.

MONTHLY RANGE OF BAROMETRICAL PRESSURE, AT ST. LOUIS, FOR 12 YEARS.

Years.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Whole Year.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1837.	0.900	1.050	1.000	0.910	0.680	0.490	0.380	0.580	0.570	0.680	0.860	0.910	1.060
1838.	1.190	0.810	0.860	0.830	0.550	0.360	0.490	0.330	0.590	0.810	1.120	1.080	1.350
1839.	1.010	1.280	1.160	0.670	0.770	0.500	0.390	0.480	0.910	0.560	1.320	0.990	1.480
1840.	1.000	1.240	0.970	0.750	0.940	0.610	0 480	0.400	0.480	0.770	0.970	0.800	1.300
1841.	1.170	0.970	1.010	1.060	0.490	0.410	0.380	0.470	0.630	0.850	1.030	1.010	1.500
1842.	1.040	1.170	0.970	0.630	0.950	0.820	0.530	0.640	0.530	0.590	1.110	1.000	1.210
1843.	1.010	1.000	1.020	0.730	0.760	0.490	0.440	0.360	0.820	0.800	1.020	0.970	1.170
1844.	1.130	0.770	0.960	0.710	0.740	0.440	0.320	0.410	0.520	0.670	0.820	1.090	1.130
1845.	0.915	1.075	1.010	0.945	0.670	0.530	0.430	0.440	0.660	0.925	0.875	0.725	1.240
1846.	1.255	1.385	1.945	1.425	0.595	0.660	0.545	0.395	0.540	0.625	0.805	1.065	1.705
1847.	1.330	0.925	0.845	0.870	0.740	0.390	0.285	0.500	0.565	0.905	1.095	0.855	1.330
1848.	1.095	1.125	1.275	0.730	0.750	0.595	0.490	0.490	0.760	1.025	0.880	1.030	1.435
Ex.Ra.	1.445	1.490	1.315	1.425	1.050	0.880	0.660	0.720	0.960	1.290	1.430	1.180	1.760

ILLUSTRATIVE ANNOTATIONS, BY DR. ENGELMANN.

TABLE I, records the mean elevation of the barometer in every single month for twelve years; the average elevation of the same through the whole period; and the mean elevation of every year. The mean of the twelve years is found to be 29.578 inches. All the figures given in the table are, of course, the result of calculation from a large number of single observations. The mean of every month has been found by taking the mean of the observations of every day at noon, and subtracting therefrom 0.005; as a number of direct observations have shown me, that this gives the true mean of the month, as near as it can be ascertained from one daily observation.

Table II, gives the minima, and table III the maxima of every month and every year of the twelve.

Table IV, is the result of both these tables, presenting the difference between the minima and maxima in every month and year. The lowest line, giving the "extreme range," shows the difference between the highest and lowest state of the barometer, that occurred at any time in January, February, etc. The last column gives the difference between the highest and lowest in each year.

The DIAGRAM, as far as possible, embodies all these results, and shows, by one glance, *First*, the mean barometrical elevation, during the twelve years, indicated by a straight, heavy line (a), and the range of the mean elevations of that period, by two lighter, straight lines (a') below, and (a'') above the first. The mean of any one year was never below the line a', nor above the line a''. *Second*. The diagram shows the mean barometrical elevation of each month during that period, by a thick, curved line (b), and by lines (b' and b''), the extremes of these monthly means. *Third*. It displays the mean of the lowest depressions of every month, by the curved line (c), while (c' and c'') are the lines indicating the lowest and highest minima of every month. In other words, during the twelve years, the lowest stage of the barometer was never below c', nor above c''. *Fourth*. Finally, it shows the mean, and the lowest and highest maxima of every month, by the lines *d*, *d′* and *d″*.

The following interesting facts are deduced from the tables, and exhibited to the eye on the diagram.

The mean elevation of the barometer, calculated at the freezing point, is 29.578 inches; the lowest and highest means 29.550 and 29.613, within the twelve years, differ only 0.063, and the mean of one year does not differ from the true mean more, at most, than 0.034.

The mean elevation of each month, during the year, gives a curve (*b*), which, in January, commences above the mean of the year, gradually descends from January and February, until it gets below the average mean (*a*) in April, and reaches its lowest point in May; it gets at or a little above the mean in September, and reaches its highest elevation in November, whence it slightly falls until January.

The means of each single month (*b′*, *b″*), vary less in January, considerably from February to May, very little from June to September, but least in August, more again in October, still more in November, and less, again, in December. The range of the barometer is smallest in summer, and especially in July, and greatest in winter, from October to March (and even April), but less so in December than in the other five months.

The highest barometrical elevation in the twelve years took place, January, 1846=30.400 in.; and the lowest depression (during a violent storm), April 28, 1846=28.640 in.; but usually the barometer does not rise above 30.241 in., nor sink below 28. 915 in.—the mean range amounting to 1.326 in.; in one year.

Other tables, not published here, show that the mean daily variation, in St. Louis, amounts to about 0.056. It is well known that, unless local influences intervene, the barometer rises and falls twice in twenty-four hours. The highest point is attained at nine A. M., and is on an average about 0.034 above the mean of the day; the lowest occurs at three P. M., and is about 0.022 below the daily mean; at ten P. M., the barometer is not so high as at nine, nor at four A. M. so low as at ten o'clock. These regular daily variations are much more considerable here than in more northern latitudes, and approach those of the tropical regions, where all these phenomena are more constant.

SECTION III.

BAROMETRICAL OBSERVATIONS AT CINCINNATI, OHIO.

From Professor Ray I have received the results of barometric observations for fourteen years. They are made out on the same plan with those of Dr. Engelmann, and will, therefore, admit of a full and instructive comparison.

TABLE I.

MEAN BAROMETRICAL ELEVATION, AT CINCINNATI, FOR FOURTEEN YEARS.—ALTITUDE 550 FEET ABOVE THE LEVEL OF THE SEA.

Years.	January.	Feby.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Whole Year.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1835.	29.310	29.460	29.368	29.249	29.286	29.304	29.346	29.338	29.371	29.403	29.334	29.464	29.353
1836.	.377	.391	.396	.347	.278	.277	.317	.364	.365	.341	.307	.381	.345
1837.	.157	.234	.349	.206	.226	.209	.289	.317	.396	.423	.335	.349	.291
1838.	.399	.316	.286	.236	.281	.303	.389	.418	.437	.328	.426	.338	.347
1839.	.379	.459	.376	.301	.215	.256	.332	.360	.340	.437	.417	.405	.357
1840.	.391	.340	.183	.348	.226	.292	.374	.372	.431	.400	.358	.404	.348
1841.	.360	.219	.247	.261	.293	.282	.391	.431	.298	.392	.294	.292	.314
1842.	.286	.270	.387	.259	.277	.275	*	*	.400	.369	.361	.379	.326
1843.	.376	.179	.303	.271	.237	.256	.310	.317	.305	.319	.373	.381	.302
1844.	.309	.334	.302	.373	.269	.265	*	*	.359	.352	.324	.204	.309
1845.	.322	.288	.350	.289	.335	.312	.232	.284	.273	.487	.305	.455	.328
1846.	.305	.320	.252	.303	.160	.241	*	*	.328	.402	.327	.328	.297
1847.	.356	.237	.336	.293	.178	.252	*	*	.255	.328	.375	.327	.294
1848.	.358	.267	.281	.394	.175	.265	*	*	.292	.252	.347	.279	.291
Mean of 14 ys.	29.335	29.308	29.315	29.295	29.245	29.271	29.331	29.356	29.346	29.374	29.349	29.356	29.352

Seasons.			
Winter, 29.333	Spring, 29.285	Summer, 29.319	Autumn, 29.356

* Absent from the City during these months.

TABLE II.

Minimum Barometrical Elevation at Cincinnati, for Fourteen Years.

Years.	Jan.	Feb.	March.	April.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Minimum of the Whole Year.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1835.	28.73	29.05	28.74	28.91	28.94	29.04	29.18	29.13	28.79	28.96	28.70	28.92	28.70
1836.	.84	28.99	.84	.96	29.06	28.96	.10	.11	29.04	.94	.73	.66	.66
1837.	.66	.54	.71	.58	28.94	.84	.04	.15	.15	29.13	.72	.81	.54
1838.	.98	.72	.73	.87	.89	.98	.26	.22	.14	.06	.97	.72	.72
1839.	.86	.76	.98	.92	.84	29.02	.14	.13	28.92	.12	.66	.75	.66
1840.	.73	.74	.53	29.08	.59	28.95	.05	.16	29.11	.11	.74	.73	.53
1841.	.83	.75	.79	28.42	.98	29.11	.16	.22	28.98	.00	.65	.70	.42
1842.	.89	.61	.83	.94	.71	.07	*	*	29.11	28.96	.74	.85	.61
1843.	.65	.88	.48	.84	.95	.07	29.17	29.18	.08	.88	.88	.94	.48
1844.	.74	.87	.86	29.19	.76	.10	*	*	.16	.81	.95	.71	.71
1845.	.83	.95	.84	.02	.99	.07	28.91	29.05	28.96	29.07	.85	29.11	.83
1846.	.85	.64	.70	28.65	.82	28.92	*	*	.99	28.91	.90	28.78	.64
1847.	.57	.63	.82	.84	.77	.89	*	*	.95	.99	29.04	.85	.57
1848.	.80	.81	.82	29.03	.94	.97	*	*	.73	.66	28.61	.47	.47
Min. of 14 Y.	28.57	28.54	28.48	28.42	28.59	28.84	28.91	29.95	28.73	28.66	28.61	28.47	28.42

* Absent.

TABLE III.

MAXIMUM BAROMETRICAL ELEVATION AT CINCINNATI, FOR FOURTEEN YEARS.

Year.	January.	Feb'y.	March.	April.	May.	June.	July.	August.	Septem.	October.	Novem.	Decem.	Maximum of the whole Year.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1835.	29.74	29.79	29.89	29.58	29.51	29.51	29.53	29.52	29.66	29.73	29.67	29.75	29.89
1836.	.68	.75	.82	.65	.55	.48	.61	.51	.57	.62	.68	.82	.82
1837.	.56	.81	.73	.51	.54	.36	.44	.49	.64	.64	.78	.63	.81
1838.	.77	.61	.69	.62	.48	.47	.60	.59	.63	.71	.91	.87	.91
1839.	.87	30.01	.88	.58	.58	.45	.55	.61	.65	.70	30.04	.62	30.04
1840.	.86	29.68	.66	.62	.47	.56	.55	.62	.72	.63	29.66	.69	29.86
1841.	.96	.59	.75	.68	.48	.47	.60	.62	.53	.70	.65	.61	.96
1842.	.75	.72	.68	.66	.63	.56	*	*	.56	.61	.71	.84	.84
1843.	.75	.61	.62	.52	.53	.54	.61	.49	.63	.77	.69	.92	.92
1844.	.62	.65	.78	.73	.56	.58	*	*	.64	.71	.75	.69	.78
1845.	.73	.76	.75	.70	.58	.55	.40	.47	.51	.85	.74	.83	.85
1846.	.94	.94	.65	.75	.48	.59	*	*	.53	.61	.73	.83	.94
1847.	.88	.62	.74	.76	.58	.42	*	*	.54	.91	.77	.65	.91
1848.	.80	.64	.86	.72	.47	.51	*	*	.29	.59	.64	.75	.86
Max. of 14 yrs.	29.96	30.01	29 89	29.76	29.63	29.59	29.61	29.62	29.72	29.91	30.04	29.92	30.04

* Absent.

TABLE IV.

MONTHLY RANGE OF BAROMETRICAL PRESSURE, AT CINCINNATI, FOR FOURTEEN YEARS.

Years.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Whole Year.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1835.	1.01	.74	1.15	.67	.57	.47	.35	.39	.87	.77	.97	.83	1.19
1836.	.74	.76	.98	.69	.49	.52	.51	.40	.53	.68	.95	1.16	1.16
1837.	.90	1.27	1.02	.93	.60	.52	.40	.34	.49	.51	1.06	.82	1.27
1838.	.79	.89	.96	.75	.59	.49	.34	.37	.49	.65	.94	1.15	1.19
1839.	1.01	1.25	.90	.66	.74	.43	.41	.48	.73	.58	1.38	.87	1.38
1840.	1.13	.94	1.13	.54	.88	.61	.50	.46	.61	.52	.92	.96	1.33
1841.	1.13	.84	.96	1.26	.50	.36	.45	.40	.55	.70	1.00	.91	1.54
1842.	.86	1.11	.85	.72	.92	.49	*	*	.45	.65	.97	.99	1.23
1843.	1.10	.73	1.14	.68	.58	.47	.44	.31	.55	.89	.81	.98	1.44
1844.	.88	.78	.92	.54	.80	.48	*	*	.48	.89	.80	.97	1.07
1845.	.90	.81	.81	.67	.60	.48	.49	.47	.56	.78	.89	.72	1.02
1846.	1.10	1.30	.95	1.10	.66	.67	*	*	.55	.70	.83	1.06	1.30
1847.	1.32	.99	.92	.91	.81	.53	*	*	.59	.93	.73	.81	1.34
1848.	.99	.82	1.04	.68	.53	.54	*	*	.84	.93	1.03	1.27	1.39
Ex. of R. 14 Y	1.390	1.470	1.410	1.360	1.040	0.750	0.700	0.570	0.990	1.250	1.430	1.430	1.620

* Absent.

The hight of the barometer at St. Louis, for the mean year, is greater than at Cincinnati; but as the latter is elevated one hundred feet above the former, an amount, equal to the atmospheric pressure of that number of feet, must be made to the one, or subtracted from the other. Wishing to make St. Louis a standard of comparison for all the barometric stations, I have applied the correction to Cincinnati, by adding .111, a ratio sufficiently accurate for our purposes. The months thus corrected are presented in the following table:

TABLE V.

COMPARATIVE MONTHLY, QUARTERLY, AND YEARLY MEAN PRESSURE AT ST. LOUIS AND CINCINNATI, CORRECTED FOR DIFFERENCE OF ELEVATION.

The difference marked + or —, as Cincinnati rises or falls from St. Louis.

Months.	St. L.	Cin'ti.	Differ.	Months.	St. L.	Cin'ti.	Differ.
	in.	in.	in.		in.	in.	in.
December.	29.636	29.467	—.169	June.	29.495	29.382	—.113
January.	29.616	29.446	.170	July.	29.544	29.442	.102
February.	29.618	29.419	.199	August.	29.567	29.467	.150
Winter.	29.623	29.444	.179	Summer.	29.535	29.430	.105
March.	29.598	29.426	—.172	September.	29.584	29.457	—.127
April.	29.540	29.406	.134	October.	29.619	29.485	.134
May.	29.493	29.356	.137	November.	29.623	29.460	.163
Spring.	29.544	29.396	.148	Autumn.	29.609	29.467	.142
Mean Year,	St. Louis, 29.578			Cincinnati, 29.434		Difference, 00.144	

SECTION IV.

BAROMETRIC OBSERVATIONS AT HUDSON, OHIO.

A profoundly scientific meteorologist, Professor Loomis, has published, in the American Journal of Science, *Vol. XLI, page* 310, the results of his observations for three years, 1838—40. Those on temperature were before us in the last chapter. Those which show the monthly mean hight of the barometer, I have arranged into a table, fitted for comparison with the tables of St. Louis and Cincinnati. Other subordinate tables have been extracted entire.

These observations are of the greater value, from being made at a place only twenty-five miles south of Lake Erie; and at an elevation nearly six hundred feet higher than any of the other stations. They present, moreover, the mean morning and afternoon elevations of the barometer, which those made at St. Louis and Cincinnati do not. These will be found in the first table, as follows:

TABLE. I.

MEAN MORNING, AFTERNOON, AND DIURNAL BAROMETRICAL PRESSURE, FOR EVERY MONTH OF THREE YEARS, 1838–40, AT HUDSON, OHIO, BY PROFESSOR LOOMIS.

Elevation above the Sea, 1131 feet; above Lake Erie, 567 feet.

Months,	January.	Feb'y.	March.	April.	May.	June.	July.	August.	Septem.	October.	Novem.	Decem.	Year.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Mean of 9 A. M.,	28.856	28.842	28.782	28.807	28.733	28.774	28.845	28.866	28.894	28.872	28.869	28.795	28.829
Mean of 3 P. M.,	28.812	28.791	28.737	28.763	28.687	28.740	28.811	28.826	28.847	28.821	28.819	28.760	28.784
Mean Diurnal Oscil., A. M. +,	+.044	+.051	+.045	+.044	+.046	+.034	+.034	+.040	+.047	+.051	+.050	+.035	+.043
Mean Pressure,	28.834	28.816	28.759	28.785	28.710	28.757	28.828	28.846	28.870	28.846	28.844	28.777	28.806
Mean Pressure, corrected for altitude of St. Louis,	29.584	29.566	29.509	29.535	29.460	29.507	29.578	29.596	29.620	29.596	29.594	29.527	29.556
Mean of St. L., for comparison,	29.616	29.618	29.598	29.540	29.493	29.495	29.544	29.567	29.584	29.619	29.623	29.636	29.578
Difference: below St. Louis marked —; above, +,	—.032	—.052	—.089	—.005	—.033	+.012	+.034	+.029	+.036	—.023	—.029	—.109	—.022

SEASONS.

		Winter.	Spring.	Summer.	Autumn.
		in.	in.	in.	in.
Mean Pressure of the Season,	(Uncorrected.)	28.809	28.751	28.810	28.853
Mean Pressure of the same, at the level of St. Louis,	(Corrected.)	29.559	29.500	29.560	29.603
Differ.: more or less than St. L.,		—.064	—.044	+.025	—.006

By this table we learn that the mean annual pressure of the atmosphere at Hudson, allowance being made for difference of topographical elevation, is .022 less than at St. Louis; while, as we have seen, that over Cincinnati, subjected to the same correction, is .144. Thus the absolute weight of the atmosphere is less at the last station than either of the others.

These diversities in the amount of mean pressure, at different places, in our Valley, do not constitute an anomaly; for, in the language of Professor Loomis, "It is now clearly proved that the mean pressure of the atmosphere, at the level of the sea, is *not* everywhere the same," and such being the fact, we should expect the mean pressure over a continent, at equal altitudes, to be unequal.

Professor Loomis has not given the monthly minima, maxima, and range, as they are presented in the tables of Dr. Engelmann and Professor Ray, but substituted for them the following occasional extremes:

TABLE II.

Elevation of the Barometer above 29.25, in Three Years.

					in.
		in.			in.
1838.	March 25, 9 A. M.	29.252	1839.	February 18, 3 P. M.	29.265
"	October 17, 9 A. M.	.305	"	March 31, 9 A. M.	.397
"	November 10, 11 A. M.	.466	"	October 21, 9 A. M.	.301
"	November 26, 9 A. M.	.251	"	November 22, 9 A. M.	.560
"	November 29, 9 A. M.	.295	1840.	January 26, 9 A. M.	.358
"	December 31, midn't.	.515	"	December 4, 9 A. M.	.272
1839.	February 6, 3 P. M.	.298	1841.	January 19, 9 A. M.	.479

TABLE III.

Depression of the Barometer below 28.25, in Three Years.

		in.			in.
1838.	February 16, 1 P. M.	28.122	1840.	March 24, 11½ A. M.	27.953
"	December 22, 4 A. M.	.079	"	May 3, 6½ P. M.	.964
1839.	February 28, 3 P. M.	.164	"	November 22, 3 P. M.	28.234
"	May 27, 3 P. M.	.240	"	December 15, 3 P. M.	.207
"	November 2, 3 P. M.	.161	"	December 26, 8 A. M.	.035
1840.	January 30, 7 A. M.	.009			

On these tables of extreme variation, Professor Loomis remarks, that being less than those observed at Montreal, New York, and Boston, places near the level of the sea, we may conclude, that for considerable elevations, the range of the barometer diminishes more rapidly than its absolute hight. But they present 1.551 as the extreme range in three years. The extreme range, for twelve years, at St. Louis, was 1.760, and for fourteen years, at Cincinnati, 1.620, numbers which confirm Professor Loomis's conclusion.

The following table of extreme oscillations, within the twenty-four hours, is extracted from the same paper with the last, and will be found the more interesting, because St. Louis and Cincinnati observations do not present tables showing the occasional diurnal fluctuations:

TABLE IV.

Fluctuations of the Barometer, not Corrected for Temperature, Exceeding six-tenths of an inch, in twenty-four hours.

Date.	Barom.	Oscillation.
1838.	in.	
Feb. 16, 1 P. M.	28.086	.680 in 21 hours
" 17, 10 A. M.	.766	
March 4, 10 A. M.	29.064	.686 in 20 hours
" 5, 6 A. M.	28.378	
Nov. 5, 3 P. M.	.327	.594 in 18 hours
" 6, 9 A. M.	.921	.608 in 24 hours
" 6, 3 P. M.	.935	
Dec. 11, 3 P. M.	.449	.601 in 24 hours
" 12, 3 P. M.	29.050	
" 28, 9 A. M.	.008	.694 in 21 hours
" 29, 6 A. M.	28.314	
1839.		
Jan. 7, 8 P. M.	28.437	.609 in 13 hours
" 8, 9 A. M.	29.046	
" 21, 3 P. M.	28.808	.503 in 24 hours
" 22, 3 P. M.	.305	
" Midnight.	.288	.512 in 7 hours
" 23, 7 A. M.	.800	.643 in 15 hours
" 23, 3 P. M.	.931	
Feb. 28, 3 P. M.	.188	.614 in 18 hours
March 1, 9 A. M.	.802	
" 29, 9 A. M.	.535	.708 in 24 hours
" 30, 9 A. M.	29.243	

Date.	Barom.	Oscillation.
1840.	in.	
Jan. 23, 2 A. .M	28.301	.638 in 31 hours
Jan. 24, 9 A. M.	28.939	
" 29, 9 A. M.	.634	.596 in 22 hours
" 30, 7 A. M.	.038	
" 30, 9 A. M.	.043	.874 in 24 hours
" 31, 9 A. M.	.917	
Feb. 12, 3 P. M.	.596	.527 in 18 hours
" 13, 9 A. M.	29.123	
" 13, 3 P. M.	.092	.711 in 24 hours
" 14, 3 P. M.	28.381	.783 in 18 hours
" 15, 9 A. M.	29.164	
Mar. 23, 9 A. M.	28.850	.813 in 24 hours
" 23, 3 P. M.	.736	.699 in 18 hours
" 24, 9 A. M.	.037	
" 24, 11½ A.M.	27.953	
" 24, 3 P. M.	28.073	.614 in 21 hours
" 25, 9 A. M.	.567	
Ap'l. 12, 9 A. M.	.532	.665 in 24 hours
" 13, 9 A. M.	29.197	
Dec. 25, 9 A. M.	28.816	.781 in 23 hours
" 26, 8 A. M.	.035	.681 in 25 hours
" 27, 9 A. M.	.716	
1841.		
Jan. 17, 9 A. M.	28.594	.712 in 24 hours
" 18, 9 A. M.	29.306	

"The greatest range, in twenty-four hours, was .874, January 30, 1840; but the most remarkable motion of all was that on the 23d of January, 1839, .512 in seven hours. It was accompanied by a most violent wind from the north, and a heavy snow. It will be observed that these extraordinary fluctuations occur chiefly in winter; not one occurred in the summer months. The same remark applies to the table of maxima and minima, given before." *Page* 314.

SECTION IV.

BAROMETRIC OBSERVATIONS AT TORONTO, CANADA WEST.

The British government has established, at Toronto (formerly Little York), a Magnetic and Meteorological Observatory, which, at this time. is under the superintendence of Captain Lefroy, of the Royal Artillery.* To that highly-cultivated and obliging gentleman, I am indebted for a number of *MS.* meteorological observations; and, also, for two volumes published by the British government, under the direction of Colonel Sabine.† The *MS.* observations will be presented first.

TABLE I.

Mean Barometric Elevation, with the Maxima, Minima, and Range, at Toronto, for Nine Years.

Altitude—above the ocean, 339 feet; above Lake Ontario, 108 feet.

Year.	Mean.	Max.	Min.	Range.
	in.	in.	in.	in.
1840.	29.654	30.385	28.694	1.691
1841.	.604	.417	.672	1.745
1842.	.612	.258	.781	1.477
1843.	.612	.263	.579	1.684
1844.	.618	.265	.614	1.651
1845.	.610	.242	.939	1.303
1846.	.628	.335	.829	1.506
1847.	.625	.396	.721	1.675
1848.	.619	.298	.863	1.435
Mean.	29.609	30.318	28.744	1.574

The barometric observations, the results of which are given in the tables compiled by Colonel Sabine, extend through two years only, and they are included in the preceding table; but as they were made at every alternate (even) hour for the whole period, they are of great value, as showing the bihorary oscillations of the instrument, at a spot remote from the sea, and nearly equidistant between the southern and northern borders of the Valley.

*The gentleman whose observations, finally, determined the position of the Pole of Magnetic Intensity for this continent. *See p.* 441.

† As, unfortunately, the communication of Captain Lefroy did not reach me until after the article temperature was printed, I will here state, that from observations for nine years, the mean heat of Toronto is 44°.39.

TABLE II.

MONTHLY MEANS OF THE BAROMETER, AT EVERY EVEN HOUR, FROM DECEMBER, 1840, TO NOVEMBER, 1842, INCLUSIVE.

In reading the decimal numbers of the table, 29 English inches must be prefixed to each set.

Months.		6 A. M.	8 A. M.	10 A. M.	Noon.	2 P. M.	4 P. M.	6 P. M.	8 P. M.	10 P. M.	Mid-night.	2 A. M.	4 A. M.	Mo. & ann. means
1840,	Dec.	.647	.664	.673	.636	.619	.635	.657	.668	.669	.646	.649	.657	.652
1841,	Jan.	.684	.691	.694	.656	.636	.643	.646	.656	.653	.663	.674	.669	.664
	Feb.	.493	.519	.526	.508	.468	.471	.483	.486	.478	.483	.475	.476	.489
	Mar.	.671	.683	.682	.664	.635	.627	.633	.645	.646	.672	.669	.664	.658
	April	.638	.647	.642	.619	.604	.595	.604	.624	.629	.621	.613	.607	.620
	May	.557	.565	.561	.543	.526	.517	.526	.550	.564	.549	.539	.543	.545
	June	.566	.577	.570	.556	.531	.516	.513	.526	.541	.536	.537	.549	.543
	July	.641	.651	.649	.627	.608	.595	.592	.602	.615	.616	.616	.625	.620
	Aug.	.722	.731	.730	.716	.694	.682	.672	.681	.687	.687	.684	.690	.698
	Sept.	.616	.628	.631	.622	.600	.587	.587	.597	.602	.597	.596	.603	.605
	Oct.	.651	.667	.663	.640	.622	.622	.634	.643	.643	.650	.644	.640	.643
	Nov.	.554	.580	.585	.568	.559	.570	.587	.597	.596	.548	.542	.544	.569
H. Means,		.620	.634	.634	.613	.592	.588	.595	.606	.610	.606	.603	.606	.609
1841,	Dec.	.610	.621	.629	.590	.569	.574	.581	.585	.581	.607	.613	.602	.597
1842,	Jan.	.528	.534	.531	.490	.474	.482	.491	.485	.483	.533	.535	.532	.508
	Feb.	.529	.562	.574	.562	.545	.554	.569	.571	.559	.524	.511	.512	.548
	Mar.	.633	.663	.671	.662	.635	.628	.631	.640	.636	.607	.620	.627	.638
	April	.578	.584	.580	.559	.538	.525	.526	.545	.547	.537	.528	.531	.548
	May	.590	.601	.603	.595	.579	.576	.582	.597	.607	.579	.575	.580	.589
	June	.607	.617	.613	.596	.579	.568	.560	.565	.573	.575	.575	.584	.584
	July	.667	.678	.679	.671	.651	.634	.632	.637	.648	.660	.650	.654	.655
	Aug.	.728	.739	.741	.732	.714	.697	.692	.701	.703	.702	.695	.698	.712
	Sept.	.677	.690	.696	.683	.663	.648	.651	.659	.657	.638	.635	.642	.662
	Oct.	.640	.659	.657	.632	.614	.602	.620	.630	.632	.648	.642	.646	.635
	Nov.	.635	.642	.640	.612	.596	.599	.605	.606	.606	.618	.614	.610	.615
H. Means,		.619	.632	.635	.615	.596	.591	.595	.602	.603	.602	.599	.602	.608

TABLE III.

The Hight of the Barometer, shown in Quarterly and Annual Means, from the preceding Table.

Twenty-nine English inches must be added to each Decimal Number in the Table.

Hours.	6 A. M.	8 A. M.	10 A. M.	Noon	2 P. M.	4 P. M.	6 P. M.	8 P. M.	10 P. M.	Mid-night.	2 A. M.	4 A. M.	M'ns.
Dec. 1840, Jan. 1841, Feb. 1841.	.608	.625	.631	.600	.574	.583	.595	.603	.600	.597	.599	.601	.601
Dec. 1841, Jan. 1842, Feb. 1842.	.556	.572	.578	.547	.529	.537	.547	.547	.541	.555	.553	.549	.551
Mean of Winter Quarters.	.582	.559	.605	.574	.552	.560	.571	.575	.571	.576	.576	.575	.576
Mar. 1841, Ap. 1841, M'y. 1841.	.622	.632	.628	.608	.588	.580	.588	.606	.613	.614	.607	.605	.608
Mar. 1842, Ap. 1842, M'y. 1842.	.600	.616	.618	.605	.584	.576	.580	.594	.597	.574	.574	.579	.591
Mean of Spring Quarters.	.611	.624	.623	.607	.586	.578	.584	.600	.605	.594	.591	.592	.600
Jun. 1841, Jul. 1841, Aug. 1841,	.643	.653	.650	.633	.611	.598	.592	.603	.614	.613	.612	.621	.620
Jun. 1842, Jul. 1842, Aug. 1842,	.667	.678	.678	.666	.648	.633	.628	.634	.641	.646	.640	.645	.650
Mean of Summer Quarters.	.655	.666	.664	.650	.630	.616	.610	.619	.628	.630	.626	.633	.635
Sep. 1841, Oct. 1841, Nov 1841.	.607	.625	.626	.610	.594	.593	.603	.613	.614	.598	.594	.596	.606
Sep. 1842, Oct. 1842, Nov. 1842.	.651	.664	.664	.642	.624	.616	.625	.632	.632	.635	.630	.633	.637
Mean of Autumn Quarters.	.629	.643	.645	.626	.609	.605	.614	.623	.623	.617	.612	.615	.622
M'n from Dec. 1840 to N. 1841	.620	.634	.634	.613	.592	.588	.595	.606	.610	.606	.603	.606	.609
M'n from Dec. 1841 to N. 1842	.619	.632	.635	.615	.596	.591	.595	.602	.603	.602	.599	.602	.608
Mean of two years.	.620	.633	.635	.614	.594	.590	.595	.604	.607	.604	.601	.604	.608

TABLE IV.

THE AVERAGE DAILY DIFFERENCE IN THE HIGHT OF THE BAROMETER, IN THE SEVERAL QUARTERS.

Quarters.		Maximum	Minimum.	Difference.	
		in.	in.	in.	in.
Winter, -	1841, - - -	29.631	29.574	.057	.053
	1842, - - -	.578	.529	.049	
Spring, -	1841, - - -	.632	.580	.052	.048
	1842, - - -	.618	.574	.044	
Summer, -	1841, - - -	.653	.592	.061	.0555
	1842, - - -	.678	.628	.050	
Autumn, -	1841, - - -	.626	.593	.033	.0405
	1842, - - -	.664	.616	.048	
In the Year,	1841, - - -	.634	.588	.046	.045
	1842, - - -	.635	.591	.044	

"We derive," says Colonel Sabine, "from these tables the following particulars relative to the (regular) diurnal variation of the barometric pressure, viz.: —

"I. The morning maximum takes place at eight o'clock in the summer quarter, and at ten o'clock in the winter quarter; in the spring and autumn quarters it is almost equally divided between those hours.

"II. The afternoon minimum takes place at two o'clock in the winter quarter, at six o'clock in the summer quarter, and at four o'clock in the spring and autumn quarters, and in the annual means.

"III. The second maximum occurs at eight o'clock, P. M., in the winter quarter, is equally divided between eight and ten o'clock in the autumn quarter, is at ten o'clock in the spring quarter, and at twelve (midnight) in the summer quarter. On the average of the whole year it is at ten o'clock.

"IV. The second minimum is at two o'clock, A. M., in the spring, summer, and autumn quarters, and on the average of the year; but in the winter quarter it occurs two hours, and occasionally four hours earlier."

In the first table of this section, the annual hight of the barometer at Toronto is given for nine years, including the two which make a part of the three preceding tables. For the annual mean, the first table may be consulted; but it differs from the mean of the two years of the other tables, only .007. Those tables, however, present the mean pressure of the different months and seasons, to exhibit which, I have constructed from them the following table, that the distribution of the pressure through the year, at Toronto, may be compared with that of St. Louis, Cincinnati, and Hudson:

TABLE V.

MEAN MONTHLY AND QUARTERLY PRESSURE AT TORONTO, FROM OBSERVATIONS AT EVERY EVEN HOUR FOR TWO YEARS.

Months,	January.	Feb'y.	March.	April.	May.	June.	July.	August.	Septem.	October.	Novem.	Decem.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Mean pressure at Toronto, for two years,	29.586	29.519	29.648	29.584	29.567	29.564	29.637	29.705	29.633	29.639	29.592	29.625
Mean pressure at St. Louis—twelve years, for comparison.	29.616	29.618	29.598	29.540	29.493	29.495	29.544	29.567	29.584	29.619	29.623	29.636
Mean pressure at Toronto, corrected for elevation of St. L.,	29.464	29.397	29.526	29.462	29.445	29.442	29.514	29.583	29.511	29.517	29.470	29.503
Difference; the sign — signifying below, + above St. L.,	—.152	.221	.072	.078	.048	.053	.030	+.016	—.073	.102	.153	.133

SEASONS.

	Winter.	Spring.	Summer.	Autumn.
	in.	in.	in.	in.
Mean Pressure at Toronto,	29.576	29.600	29.635	29.621
Same, when brought to the altitude of St. Louis,	29.454	29.478	29.513	29.499
Difference of St. Louis, and Toronto corrected,	—.169	.066	.022	.109

SECTION V.

BAROMETRICAL OBSERVATIONS AT MONTREAL, CANADA EAST.

Montreal lies nearly north-east of St. Louis, being 6° 54′ north, and 16° 42′ east. The other stations, Cincinnati, Hudson, and Toronto, lie between these extremes. Montreal, moreover, is near the level of the sea. Mr. McCord, of that city, has published* the annual mean of five years' observations, his barometer being placed ninety-one feet above the mean tide in the St. Lawrence. The monthly means are not given. As this is the last of our stations, I have added, as far as practicable, the annual results for the *same* years at the other stations, all brought to the elevation of St. Louis; but, in the footing out of the table, the means of all the observations at the several stations are put down.

Table of Mean Annual Barometric Pressure and Range, at Montreal, for Five Years, from 1836 to 1840 inclusive, with corresponding Years at the other stations.

Altitude, 91 feet above the Sea.

Year.	Mean Pressure at Mont'l	Montreal cor. for St. Louis	Mean of St. Louis	Mean of Cincinnati.	Mean of Hudson.	Mean of Toronto.	Annual Range at Montreal.
	in.	in.	in.	in.	in.	in.	in.
1836,	29.920	29.522	—	29.456	—	—	1.550
1837,	.823	.425	29.555	.402	—	—	1.758
1838,	.884	.486	.613	.458	—	—	1.498
1839,	.909	.512	.578	.468	—	—	2.128
1840,	.895	.497	.578	.459	29.528	29.532	1.569
Mean,	29.886	29.488	29.578	29.434	29.556	29.487	1.700

SECTION VI.

GENERALIZATIONS.

I. Comparative Mean Annual Pressure at the Different Stations.—When we compare the mean pressure of the five stations, as presented at the foot of the Montreal table, the whole being brought to the altitude of St. Louis, four hundred and fifty feet, we find the average 29.509. St. Louis, the highest, stands over Cincinnati .144, Hudson .022, Toronto .091, and Montreal .090. Of the whole, Cincinnati differs most from St. Louis, and Hudson least. When we bring the mean of each station into comparison with that of the whole, 29.509, St. Louis and Hudson are found above it, Cincinnati, Toronto, and Montreal below. Such is the mean pressure within a parallelogram, extending north-east, from the banks of the

* Amer. Jour. of Sci., Vol. XLI.

middle section of the Mississippi River, nearly to the head of tidewater in the St. Lawrence; and he who resides within it, and knows his elevation, can, without much probability of error, calculate the pressure of the atmosphere in which he lives. How far this is applicable to other parts of the Valley, can be known only by observation.

II. Relative Mean Pressure of the Months and Seasons at the Different Stations.—In these comparisons Montreal cannot be introduced, because its monthly pressure is not given in the table. Of the other stations, St. Louis is taken as the standard, to which the rest are brought by correction for difference of altitude.

1. *St. Louis.*—The highest month is December, being .058 above the mean of the year at that place; the lowest May, .085 below: the range between them .143. The month nearest to the mean year is September, being .006 above it. Of the whole, September, October, November, December, January, February, March, rise above it; while April, May, June, July, and August sink below. Of the seasons, autumn and winter are above, spring and summer below. Winter is the highest and summer the lowest of the four. The difference between them is .088 Autumn is higher than spring by .055. The season which comes nearest to the mean year is autumn, .031 above.

2. *Cincinnati.*—The monthly table for this place gives the following results: October the highest, being .051 above its mean year; May the lowest, .072 below the year — the range between them, .123. July, August, September, October, November, December, and January exceed the yearly mean; February, March, April, May, and June fall below it. The month nearest to its mean year is July, being .008 above. Of the quarters, autumn and winter are above, spring and summer below. Autumn is the highest of the whole; spring the lowest — the difference between them is .071. Winter is higher than summer by .014. The season nearest to mean annual pressure is summer, being only .004 above.

3. *Hudson.*—The month of highest mean pressure is September, being .064 above its mean year.; of lowest, May, being .096 below — range between them, .160. January, February, July, August, September, October, and November are above; March, April, May, June, and December below. The month nearest to the annual mean is February, being only .010 above. Of the seasons, summer, autumn, and winter are above, spring alone below. Autumn is the highest season; spring the lowest — difference between them .103. Summer is higher than winter by .001 only. The season which approaches nearest to the mean yearly pressure is winter, being .003 above.

4. *Toronto.*—At this station, the month of greatest mean pressure for two years is August, .097 above its annual mean; the lowest February, .089 below — the range between them .186. The months which rise above the yearly mean are March, July, August, September, October, and December; those below are January, February, April, May, June, and November. The one which comes nearest to the year is December, being .017 above.

Of the seasons, summer and autumn are above; winter and spring below the mean year. Summer has the highest mean; winter the lowest — difference .058. Autumn rises over spring .021. Of the seasons, spring approaches nearest, being .008 less.

It will be profitable to throw these analyses into a tabular form:

TABLE OF BAROMETRIC DIVERSITIES IN MEAN PRESSURE.

Places,	St. Louis, 12 yrs.	Cin'ti, 14 yrs.	Hudson, 3 yrs.	Toronto, 2 ys.
Highest month,	December	October	September	August
Lowest month,	May	May	May	February
Months which rise above mean year,	Dec. Nov. Oct. Feb. Jan. March September	Oct. Aug. Dec. Nov. Sept. Jan. July	Sept. Oct. Aug Nov. Jan. July February.	Aug. Mar. Oct. July Sept. Dec.
Months which sink below mean year,	Aug. July June May April	March Feb. April June May	April Dec. March June May	Nov. Jan. April May June Feb.
Month nearest mean year,	September	July	July	December
Seasons above mean year,	Autumn Winter	Autumn Winter	Autumn Summer Winter	Summer Autumn
Seasons below mean year,	Spring Summer	Summer Spring	Spring	Spring Winter
Season nearest mean year,	Autumn	Summer	Winter	Spring

An inspection of this table shows that, in the region of country from St. Louis to Toronto inclusive, while the mean pressure of no station differs more than .080, from the average of the four stations, there is great diversity in the distribution of the pressure throughout the year. Thus the months of highest pressure are not the same at any two stations, and they belong to three different seasons; nearly the same being true of the lowest months. Nor are the months which rise above or fall below the mean annual pressure, the same at any two places; and the month which approaches nearest to that pressure is a different one at each place, and belongs to three of the seasons. The seasons, however, display a tendency to order. At every station autumn is above mean pressure; winter is above at three, and summer at two—on the other hand, spring is below at all the stations, thus antagonizing autumn; summer is below at two, being equally divided; and winter is below at one only. These facts indicate, as a general law, that in autumn the pressure is greatest, next to which comes winter; then summer, and then spring. Yet, in connection with this approach to uniformity, it is curious to observe, that a different season for each station, is that which comes nearest to, or best represents its mean yearly pressure. It is also worthy of remark, that at three stations out of four, the mean pressure of seven months, is above mean annual pressure—at the other the months are equally divided. Hence it follows, that the fall of the barometer below the annual mean, is greater than its rise above, in the proportion of seven to five: that is, the sum of the five *minus* months, is equal to the sum of the seven *plus* months.

III. EXTREME ANNUAL RANGES.—For determining the relative extreme ranges of the barometer at different places, it is not so important to have the observations corrected for temperature and capillarity, as when the relative mean pressure is the object; I shall, therefore, under the present head, refer to two sets of observations not hitherto noticed; those of Mr. Lillie, for two years, at New Orleans, on the Gulf Coast, in N. Lat. 30°; and those of Sir E. Parry, for two years, north of Hudson Bay, below and above the arctic circle.* These distant and opposite stations, when compared with St. Louis, Cincinnati, Hudson, Toronto, and Montreal, will afford a satisfactory expression of the annual and monthly extreme ranges for the whole Interior Valley. The extreme annual ranges, at those stations, are as follows: New Orleans 0.790; St. Louis 1.760; Cincinnati 1.620; Hudson 1.607; Toronto 1.675; Montreal 1.700; Arctic Circle 2.160. These numbers show that as the mean temperature of the year decreases, the barometric range increases. I shall not attempt, on so small a number of data, to develop these inverse ratios; but it may be stated, that the mean range for the five stations, from St. Louis to Montreal inclusive, is 1.672, and their mean N. Lat. 41° 38′, giving .076 of increased barometric range for a degree of latitude at New Orleans. The mean temperature of the same stations is 49°, that of the city 70°; showing an increase of barometric range to the amount of 0.882, for a loss of 21° of mean temperature which is .042 for a degree of temperature. There is, also, a relation between the extreme annual ranges of the barometer, and those of the thermometer, as appears from the following table:

Places.	Yearly Bar. Range.	Yearly Thr. Range.
	in.	°
New Orleans,	0.790	86
St. Louis,	1.760	134
Cincinnati,	1.620	117
Hudson,	1.607	102
Toronto,	1.675	119
Montreal.	1.700	126

These numbers show, without a single exception, that the barometric and thermometric ranges are in harmony, or direct proportion to each other. In this comparison, St. Louis requires a special notice. Although the most

* Second Voyage.

southern of the five interior stations, it exceeds them all in the extent of both its ranges. This, I presume, arises from its being the most western that nearest to the great plains and the Rocky Mountains, and suggests, that as we travel westwardly, on the same parallel of latitude, these ranges of temperature and pressure become more extended. The observations made in the Arctic regions are, as yet, too few to admit of a satisfactory comparison on these points; but they seem to indicate a change of the law of relation, for while the extreme barometric range observed, in two years, was 2.160, or nearly a third more than the mean of the middle stations, the range of the thermometer wos only 100°, or four-fifths of the mean range of those stations. It is probable, then, that there is a point, high up in the temperate zone, where both ranges acquire their maxima, and from which they decrease to the south and to the north.

IV. Extreme Monthly and Quarterly Ranges.—As, by the annual range, is meant the distance between the highest and lowest states of the barometer, through the whole period in which observations are made, so, by the monthly and quarterly, is meant the range between the highest and lowest, in the same month or the same quarter, though making integral parts of different years. They show the highest and lowest points of oscillation to which that month or season is liable. As these maxima and minima are, also, the data from which the yearly extremes are calculated, it follows that the latter must indicate the former; but they do not tell us of the month or seasons in which the extreme librations have their *termini;* and, therefore, we are left to inquire into the relative monthly and seasonal oscillations.

If we ascertain the mean of the extreme monthly ranges, at each station, and compare that of each month with it, some will, of course, rise above, and others fall below the average; and, thus, without embarrassing ourselves with numbers, we may perceive, in a general way, which are the months of higher, and which of lower range; as in the following table, where, moreover, the months of both columns are placed in the order of their distance from the mean of the whole, and the amount of the highest and lowest is annexed. Thus, the first-named month of the first column has the highest range of any in the year, and the last of the second column the lowest; while the last month of the first column, and the first month of second column, are those whose range approaches nearest to the mean of the whole; in other words, are the months of temperate range.

EXTREME MONTHLY BAROMETRIC RANGES AT FIVE STATIONS.

Places and Years.	Highest Range.	Months above mean range, in the order of their extent.	Mean Range.	Months below mean range, in the order of their extent.	Lowest Range.
New Orleans: 3 years,	0.687	Nov. Feb. Dec. Jan. Mar. Oct. May	0.441	Apr. June Aug. Sept. July	0.207
St. Louis: 12 years,	1.490	Feb. Jan. Nov. Apr. Mar. Oct. December	1.154	May Sept. June August July	0.660
Cincinnati: 14 years,	1.470	Feb. Nov. Dec. Mar. Jan. April October	1.149	May Sept. June August July	0.700
Toronto: 3 years,	1.534	Feb. Jan. Nov. Oct. Dec. Mar.	1.167	Sept. June April July May August	0.725
Arctic Regions: 2 years,	2.040	Mar. Oct. Feb. June January	1.388	Apr. Nov. May July Aug. Dec. September	1.010

In this table we perceive that from south to north, quite across the continent, the great oscillations of the barometer occur chiefly in the colder months. At New Orleans they are found highest in all the winter months, with two months of spring and two of autumn: At St. Louis and Cincinnati, the same: At Toronto, in all the winter months, together with two autumn and one spring month. But in the Arctic Regions, this order is, in some degree, broken up, two of the winter months, and one month of spring, summer, and autumn, being above mean range; still giving, however, a preponderance to the colder months. At New Orleans the highest month is November; in the distant north, March; at the three middle stations, February. The lowest month at New Orleans, St. Louis, and Cincinnati, is July; at Toronto, August; in the north, September. In New Orleans and and Toronto, the number of months above and below mean range, is equal; at St. Louis and Cincinnati, as seven to five; in the north, as five to seven. In the southern city, the month of lowest range is less than a third of the highest; at St. Louis, about half way between a third and a half; at Cincinnati and Toronto, nearly a half; at the Arctic Circle, within .020 of equality. Thus the difference in extent of range, between the summer and winter months, diminishes, as we advance from south to north.

When we group the months into seasons, we find the winter months, with the exception of December in the Arctic Regions, above mean range; the summer, except June, in the same regions, below; May leans to the lower range, being in it at four stations, and in the upper at one only. At all the stations, September is below, and October above; at four, November is above, at one below. Thus spring and autumn are almost equally divided, the former, however, inclining a little to the lower, and the latter to the higher group of ranges.

SECTION VII.

PHYSIOLOGICAL AND ETIOLOGICAL EFFECTS OF VARYING ATMOSPHERIC PRESSURE.

In a country of such uniform elevation as the Interior Valley of our continent, most of the inhabitants live under the same mean pressure. It has been already estimated that the majority reside about six hundred feet above the level of the sea; and, therefore, according to data, supplied by the preceding table, they live under a mean pressure, indicated nearly by 29.350, or .978 of the atmosphere resting on those at the level of the Gulf. But there are extensive table-lands, stretching off from the Appalachian Mountains, in Pennsylvania, Ohio, and New York, whose inhabitants reside under a pressure indicated by about 28.7, or .957 of the whole atmosphere; and on the terraces of the Cordilleras of Mexico, and the southern Rocky Mountains, there is a considerable population which move in an atmosphere, the average weight of which must be far less; while, on the other hand, the inhabitants of the shores of the Gulf of Mexico, and of the estuary of the St. Lawrence, live under the pressure of nearly the whole column of atmosphere, equal to thirty inches of the barometer.

These differences, ranging through several inches of the barometric scale, may fairly be presumed to exert an influence on our physiology, however difficult it may be to ascertain its kind or degree. Our constitutions, no doubt, become accommodated to the atmospheric pressure to which, from birth or long residence, they have been accustomed; as they are known to become used to climates, the mean temperatures of which are very different. The inhabitants of each climate feel a change of temperature, though it may not rise as high as that in which persons further south reside; nor fall as low as that in which persons further north enjoy themselves; and it cannot, I think, be doubted, that those who live under the sea-side pressure of the whole atmosphere, and those who reside at an elevation, which reduces the pressure an eighth or a tenth, are equally affected by a rise or fall of the barometer through the same range. In other words, a depression or elevation of the mercury, amounting to half an inch, would, I suppose, be as sensibly felt by the inhabitants of the Gulf coast, at the mouth of the Rio del Norte, as by those of Santa Fe, or the Valley of Taos, among its upper waters, six thousand feet higher. From these facts we may, I suppose, reiterate the conclusion, that mean pressure is a physiological and etiological influence, which should not be overlooked, in making a recognition of the physical agencies which modify the human constitution.

But the influence of the oscillations of pressure on the same level, are of deeper interest than the mean pressure at different elevations. A sudden diminution of pressure, is equivalent to the rapid ascent of a mountain—a sudden elevation, like the descent from a mountain into the valley below; except, that when the barometer falls, the temperature of the air generally rises, and when the barometer mounts upward, the temperature commonly diminishes; while in ascending a mountain, the heat decreases, *pari passu*, with the weight of the atmosphere; and, in descending, it augments with the increase of pressure. Still further, the oscillations of atmospheric weight and temperature are, no doubt, accompanied by modifications in the humidity and electricity of the air, whereby the direct influence of variations of pressure are obscured. Thus the problem becomes complex, and we are thrown back upon a few well-ascertained and familiar facts. *First.* It is within the experience of every one, that when the barometer is low, and smoke, vapor, and fogs linger near the surface of the earth, the body feels languid, fatigue soon follows on exertion, and the intellectual functions are reduced in their activity; effects which occur even in winter, when they cannot be ascribed to increase of temperature. To what extent this physiological change may predispose to disease, deserves to be considered. On the other hand, when the barometer ranges high, there is a feeling of vigor and activity in both body and mind, disproportionate, I think, to the mere reduction of temperature, which is generally connected with that change. These vicissitudes, it is well known, are apt to generate inflammations of the lungs, joints, and other parts of the body, which are commonly ascribed to changes of temperature only; but it may, fairly, be presumed, that the diminution of pressure is a predisposing, its sudden increase a coöperative, exciting cause of these effects. *Second.* The other facts, which bear on the question, have been reported by those who have ascended high mountains. Captain Fremont, in ascending the Rocky Mountains, had two attacks of dizziness and vomiting, when the barometer stood at about twenty inches; and those who have ascended to greater hights elsewhere, have suffered extreme lassitude, uneasiness, vertigo, nausea and vomiting, dyspnœa, and hemorrhages from the mucous membranes; effects, apparently, attributable to nothing but the diminished weight and density of the atmosphere.

CHAPTER IV.

WINDS OF THE INTERIOR VALLEY.

SECTION I.

INTRODUCTORY OBSERVATIONS.

Every physician must know, that winds are currents of air, created by inequalities of temperature in the atmosphere over different places. When a portion is heated, it expands, becomes lighter, rises, and flows off in some or every direction; and, at the same time, the cooler and denser air, around and near the surface of the earth, flows toward the base of the rarified columns. In this manner, not only local but general winds are originated; such as those which precede, accompany, or follow a thunderstorm; and, also, those which blow from the tropical to the polar regions, *et vice versa.* But changes of temperature are the effect, not less than the cause of winds. When the atmosphere moves from a southerly to a northerly point, the temperature rises—from a northerly to a southerly, it falls; if the wind blow from a low plain or valley, upon a mountain, the elevated region becomes warmer—if from the latter, a current roll down upon the valley, the temperature sinks. In all these movements the weight or pressure of the affected atmosphere is modified.

In some fundamental points all the movements of the great aerial ocean agree; as, for example, that the equatorial currents, when they flow off toward the poles, assume, from the diminishing velocity of the earth in the higher latitudes, the character of south-westerly winds in the northern hemisphere, and of north-westerly in the southern; while they raise the temperature of the colder climates; and, that the returning or compensating currents, as they advance toward the equatorial regions, from the increasing velocity of the earth's surface, seem turned from their original course, toward the west, assuming the direction of north-east and, at last, of east winds.

But the winds of every country have peculiarities which depend on the vicinity or distance of seas, and broad lakes, mountain chains, deep valleys, large rivers, and extensive savannas or forests. In the second section of the first chapter on Climate, *page* 453, a general recognition of these great features of our Interior Valley was made, and need not be here repeated. I shall, therefore, proceed to remark, that to construct an accurate system of the winds of any country, is a labor of much magnitude and difficulty. To do it for our Interior Valley, at this time, is quite impracticable, for reasons which may be briefly stated: *First.* Observations have not been made at a sufficient number of places. *Second.* They have not, in general, included the velocity of the wind, or the length of time it blew from a particular point. *Third.* They have not been made on any uniform plan, and many of the tables are, therefore, not susceptible of being compared. *Fourth.* The duration of calms, and their relative frequency, before and after winds, has seldom been noted. *Fifth.* The course of the upper winds, as indicated by the movements of the clouds, has not often been recorded, in connection with the direction of the currents at the surface of the earth. *Sixth.* Observations, with two or three exceptions, have not, in general, been made in the night.

Until these *desiderata* shall be supplied, it will be in vain to attempt a full development of the laws which govern the atmospheric movements over the interior of our continent; and I shall limit myself to the presentation of the results of observation at such a number of places, scattered over it, as will give a general view of this branch of its meteorology. In doing this, I propose to begin in the south and advance into the north. In constructing the tables, I have reduced all the observations to eight points of the compass, adding a column for calms. The latitude, longitude, elevation, and relation to seas, lakes, or mountains of each station, may be seen by a reference to the general table of mean temperatures, *page* 455, or to the topographical descriptions in ***Part I.***

I shall first present the observations recorded at our different military posts, which may, with the greater propriety, be thrown together, as they were made on the same plan and under one direction—that of the bureau of the Surgeon-general at Washington.* In these tables, the single observations, several times a day, are not given, but the numbers represent days. No post at which observations were made for less than three years, are included. A mean year for each post has been made out. The whole numbers represent days, and the decimals parts of days. There is no column of calms.

SECTION II.

TABULAR VIEWS OF THE WIND AT OUR MILITARY POSTS.

TABLE I.—CANTONMENT CLINCH, PENSACOLA BAY.

MEAN MONTHLY PREVALENCE OF THE WIND FOR SEVEN YEARS—1822–'29.

Months.	E.	S. E.	S.	S. W.	W.	N. W.	N.	N. E.	Prev. Winds.
January, ...	1.4	4.9	5.1	2.9	1.6	5.4	4.1	5.4	N. E.
February, ...	1.7	4.3	3.6	6.1	0.6	4.6	4.6	4.4	S. W.
March, ...	2.9	5.7	6.1	7.4	1.4	3.9	2.7	2.1	"
April, ...	0.3	7.0	6.1	10.0	0.9	3.1	1.6	1.0	"
May, ...	1.0	3.1	8.0	13.7	0.9	3.0	0.9	1.1	"
June, ...	0.1	3.4	4.1	14.6	2.4	1.9	0.9	1.3	"
July, ...	0.7	3.3	3.4	13.6	1.4	3.0	2.4	1.6	"
August, ...	0.6	4.3	4.1	10.3	1.3	3.4	1.4	4.0	"
September, ...	1.1	7.4	3.4	8.6	2.0	3.4	2.1	3.0	"
October, ...	1.0	8.0	3.1	3.4	0.7	5.0	4.0	5.9	S. E.
November, ...	1.6	7.0	2.4	3.7	0.6	7.7	3.9	2.9	N. W.
December, ...	2.9	7.0	3.9	2.6	1.4	5.3	2.6	5.0	S. E.
Year, ...	15.3	65.4	53.3	96.9	15.2	49.7	31.2	37.7	

MEAN YEAR IN ANTAGONISTIC ORDER.

Course of Wind.	Days.	Course of Wind.	Days.	Preponderance.	Days.
IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.					
East,	15.3	West,	16.2	West over East,	0.9
South-east,	66.4	North-west,	50.7	S. E. " N.W.,	15.7
South,	55.2	North,	31.2	South " North,	24.0
South-west,	97.9	North-East,	38.7	S. W. " N. E.,	59.2
IN FOUR DIRECTIONS, OR QUADRANTS.					
South-east,	101.6	North.west,	74.4	S.E. over N.W.,	27.2
South.west,	133.6	North-east,	62.0	S. W." N. E.,	71.6
IN SEMI-CIRCLES.					
Eastern,	163.6	Western,	208.0	W. over E.	44.4
Southern,	235.2	Northern,	136.4	S. " N.	98.8

* Meteor. Register U. S. A., 1840.

TABLE II.—FORT JESUP.

MEAN MONTHLY PREVALENCE OF THE WIND FOR EIGHT YEARS—1823–'30.

Months.	E.	S. E.	S.	S. W.	W.	N. W.	N.	N. E.	Prev. Winds.
January,......	3.6	3.6	3.5	5.7	3.0	4.7	3.4	4.5	S. W.
February,.....	3.1	6.9	2.7	2.7	1.4	3.6	3.4	4.5	S. E.
March, ...	2.1	7.5	3.2	3.4	2.5	5.9	2.5	4.1	"
April, ...	2.8	4.9	2.5	4.7	1.9	3.7	3.6	6.0	N. E.
May, ...	2.9	6.4	6.0	4.5	2.2	2.7	2.1	4.1	S. E.
June,.........	3.9	6.6	4.7	6.4	1.2	2.5	0.5	4.1	"
July, ...	2.5	6.4	4.5	5.1	2.8	2.9	2.7	4.5	"
August, ...	2.5	5.5	3.7	3.8	1.9	3.1	3.9	7.0	N. E.
September,....	4.0	4.0	2.1	2.2	0.6	3.7	4.1	8.5	"
October, ...	3.2	6.0	2.5	3.0	0.9	5.6	3.0	6.7	"
November,....	2.2	4.9	2.9	5.2	2.1	5.8	2.2	5.0	N. W.
December, ...	2.0	7.6	3.0	3.6	0.9	6.7	3.2	4.0	S. E.
Year,.......	34.8	71.3	41.3	50.3	21.4	50.9	34.6	63.0	

MEAN YEAR IN ANTAGONISTIC ORDER.

Course of Wind.	Days.	Course of Wind.	Days.	Preponderance.	Days.
IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.					
East,	34.8	West,	21.4	East over West,	13.4
South-east,	71.3	North-west,	50.9	S. E. " N. W.	20.4
South,	41.3	North,	34.6	South " North,	6.7
South-west,	50.3	North-east,	63.0	N. E. " S. W.	12.7
IN FOUR DIRECTIONS, OR QUADRANTS.					
South-east,	109.4	North-west,	78.9	S. E. over N. W.	30.5
South-west,	81.7	North-east,	97.7	N. E. " S. W.	16.0
IN SEMI-CIRCLES.					
Eastern,	207.1	Western,	160.6	E. over W.	46.5
Southern,	191.1	Northern,	176·6	S. " N.	14.5

TABLE III.—FORT GIBSON.

MEAN MONTHLY PREVALENCE OF THE WIND FOR THREE YEARS—1828–'30.

Months.	E.	S. E.	S.	S. W.	W.	N. W.	N.	N. E.	Prev. Winds.
January,......	1.7	15.0	0.7	1.0	0.0	0.7	5.3	6.7	S. E.
February,.....	1.3	15.3	0.7	1.3	0.0	3.0	3.0	3.7	"
March, ...	1.3	18.0	0.0	0.0	0.0	3.3	1.7	6.7	"
April, ...	1.3	16.7	1.7	1.7	0.3	5.0	1.3	2.0	"
May, ...	0.7	28.3	0.0	0.0	0.0	1.0	0.3	0.7	"
June,.........	1.0	25.3	0.3	1.0	0.3	0.3	0.0	1.7	"
July, ...	1.0	15.0	0.3	4.7	0.3	3.7	0.3	5.7	"
August, ...	1.7	22.7	1.7	0.3	0.0	0.3	1.0	3.3	"
September,....	1.7	13.3	1.0	0.3	0.0	0.3	5.0	8.3	"
October, ...	4.3	16.3	0.7	0.0	1.0	4.3	2.3	3.0	"
November,....	4.0	11.7	0.3	1.3	1.3	5.7	3.7	2.0	"
December, ...	2.7	13.3	0.3	1.0	1.3	6.0	0.3	6.0	"
Year,.......	22.7	210.9	7.7	12.6	4.5	33.6	24.2	49.8	

MEAN YEAR IN ANTAGONISTIC ORDER.

Course of Wind.	Days.	Course of Wind.	Days.	Preponderance	Days.
IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.					
East,	22.7	West,	4.5	East over West,	18.2
South-east,	210.0	North-west,	33.6	S. E. " N.W.,	177.3
South,	7.7	North,	24.2	North " South,	16.5
South-west,	12.6	Northeast,	49.8	N. E. " S. W.,	37.2
IN FOUR DIRECTIONS, OR QUADRANTS.					
South-east,	226.1	North-west,	47.9	S. E. over N. W.	226.1
South-west,	18.7	North-east,	73.3	N. E. " S. W.	55.2
IN SEMI-CIRCLES.					
Eastern,	299.4	Western,	65.6	E. over W.,	233.9
Southern,	244.8	Northern,	121.2	S. " N.,	123.5

TABLE IV.—JEFFERSON BARRACKS.

MEAN MONTHLY PREVALENCE OF THE WIND FOR FOUR YEARS, 1827–30.

Months.	E.	S. E.	S.	S. W.	W.	N. W.	N.	N. E.	Prev. Winds.
January, ...	0.5	3.0	7.2	2.7	3.2	7.8	4.5	2.7	N. W.
February, ...	1.5	6.5	4.5	1.2	2.0	7.7	2.7	2.0	"
March, ...	1.7	6.7	3.2	5.7	2.5	6.2	3.7	1.0	S. E.
April, ...	1.2	6.7	6.8	5.0	3.2	5.7	0.8	4.5	S.
May, ...	1.5	2.0	7.7	3.2	5 0	5.0	4.2	2.2	"
June, ...	0.5	3.8	10.5	5.2	2.8	5.5	1.5	0.8	"
July, ...	0.5	4.7	6.5	4.0	2.7	4.8	4.5	3.2	"
August, ...	4.8	7.2	8.5	5.2	0.8	2.0	0.5	2.0	"
September, ...	1.2	4.5	4.0	4.2	2.8	5.7	3.0	4.5	N. W.
October, ...	2.0	5.0	2.8	5.5	5.0	5.8	2.8	2.2	"
November, ...	1.7	5.0	4.7	4.8	2.2	6.5	3.5	1.5	"
December, ...	0.7	5.2	5.7	3.5	1 8	5.7	4.0	4.3	S.& N.W.
Year, ...	17.8	60.3	72.1	50.2	34.0	68.4	35 7	30.9	S.

MEAN YEAR IN ANTAGONISTIC ORDER.

IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.

Course of Wind.	Days.	Course of Wind.	Days.	Preponderance.	Days.
East,	17.8	West,	34.0	West over East,	16.2
South-east,	60.3	North-west,	68.4	N. W. " S. E.,	8.1
South,	72.1	North,	35.7	S. " N.,	36.4
South-west,	50.2	North-east,	30.9	S. W. " N. E.	19.3

IN FOUR DIRECTIONS, OR QUADRANTS.

South-east,	105.2	North-west,	103.2	S. E. over N.W	2.0
South-west,	103.3	North-east,	57.7	S. W. " N. E.	45.6

IN SEMI-CIRCLES.

Eastern,	162.9	Western,	206.5	W. over E.	43.6
Southern,	208.5	Northern,	160.9	S. " N.	47.6

TABLE V.—COUNCIL BLUFFS.

MEAN MONTHLY PREVALENCE OF THE WIND FOR FIVE YEARS, 1822–'26.

Months.	E.	S. E.	S.	S. W.	W.	N. W.	N.	N. E.	Prev. Winds.
January,......	0.4	4.0	7.0	2.2	1.0	5.6	8.4	2.4	N.
February,.....	0.4	2.4	5.2	3.0	2.4	7.8	6.4	1.0	N. W.
March, ...	0.8	4 2	3.6	2.0	1.2	6.6	10.6	1.0	N.
April, ...	1.8	4.4	8.2	1.8	2.2	4.0	5.4	2.2	S.
May, ...	1.8	3.6	12.2	2.6	1.8	3.8	2.8	2.4	"
June,.........	3.2	4.8	9.8	2.6	1.8	2.0	3.2	2.6	"
July, ...	3.2	6.0	9.8	3.6	0.6	2.6	2.6	2.6	"
August, ...	3.4	2.8	12.0	2.6	2.6	2.0	5.6	2.2	"
September,....	2.4	4.0	8.2	3.6	1.2	4.6	3.4	2.2	"
October, ...	1.0	3.6	7.6	5.0	1.6	4.0	7.6	0.6	S. W.
November,....	0.4	2.4	6.8	1.2	1.8	5.2	10.4	1.8	N.
December, ...	0.6	2.4	5.8	1.4	0.6	4.8	13.2	2.0	"
Year,.......	19.4	44.6	96.2	31.6	18.8	53.0	79.6	23.0	S.

MEAN YEAR IN ANTAGONISTIC ORDER.

IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.

Course of Wind.	Days.	Course of Wind.	Days.	Preponderance.	Days.
East,	19.4	West,	18.8	East over West,	0.6
South-east,	44.6	North-west,	53.0	N. W. " S. E.	8.4
South,	96.2	North,	79.6	South "North,	16.6
South-west,	31.6	North-east,	23.0	S. W. " N. E.	8.6

IN FOUR DIRECTIONS, OR QUADRANTS.

South-east,	102.4	North-west,	102.2	S. E. over N. W.	0.2
South-west,	89.1	North-east,	72.5	S. W. " N. E.	16.6

IN SEMI-CIRCLES.

Eastern,	174.9	Western,	191.3	W. over E.	16.4
Southern,	191.5	Northern,	174.7	S. " N.	16.8

TABLE VI.—FORT ARMSTRONG—ROCK ISLAND.

MEAN MONTHLY PREVALENCE OF THE WIND FOR FOUR YEARS, 1827–'30.

Months.	E.	S. E.	S.	S. W.	W.	N. W.	N.	N. E.	Prev. Winds.
January, ...	3.5	3.0	5.2	0.8	4.2	4.2	8.5	1.5	N.
February, ...	1.5	0.5	8.5	1.0	4.2	4.5	6.0	2.0	S.
March, ...	2.2	1.2	13.2	1.8	3.0	2.5	3.5	3.5	S.
April, ...	3.7	2.0	6.5	1.7	4.2	1.8	7.0	3.0	N.
May, ...	2.2	2.0	12.2	1.7	4.2	1.2	3.5	3.7	S.
June, ...	2.2	2.5	13.8	1.8	3.0	2.0	3.0	1.5	S.
July, ...	1.5	2.5	9.8	5.0	3.0	2.0	6.5	0.8	S.
August, ...	3.2	2.0	11.5	3.8	2.8	0.5	4.8	2.5	S.
September, ...	3.2	3.8	5.5	1.5	1.8	2.8	8.0	3.5	N.
October, ...	2.7	2.2	10.0	1.7	5.5	1.7	4.5	2.5	S.
November, ...	4.8	1.2	6.0	3.5	3.2	3.7	6.8	0.8	N.
December, ...	3.0	2.2	8.0	4.2	4.5	2.8	4.7	1.5	S.
Year, ...	33.7	25.1	110.2	28.5	44.6	29.7	66.8	26.8	S.

MEAN YEAR IN ANTAGONISTIC ORDER.

Course of Wind.	Days.	Course of Wind.	Days.	Preponderance.	Days.
IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.					
East,	33.7	West,	44.6	West over East,	10.9
South-east,	25.1	North-west,	29.7	N.W. " S. E.,	4.6
South,	110.2	North,	66.8	South " North,	43.4
South-west,	28.5	North-East,	26.8	S. W. " N. E.,	1.7
IN FOUR DIRECTIONS, OR QUADRANTS.					
South-east,	97.0	North.west,	85.4	S.E. over N.W.,	11.6
South.west,	105.9	North-east,	77.0	S. W." N. E.,	28.9
IN SEMI-CIRCLES.					
Eastern,	174.0	Western,	191.3	W. over E.	17.3
Southern,	202.9	Northern,	162.4	S. " N.	40.5

TABLE VII.—FORT SNELLING.

MEAN MONTHLY PREVALENCE OF THE WIND FOR EIGHT YEARS, 1822–'30.

Months.	E.	S. E.	S.	S. W.	W.	N. W.	N.	N. E.	Prev. Winds.
January, ...	0.5	2.7	4.0	8.2	5.7	6.1	2.5	0.9	S. W.
February, ...	0.5	2.1	4.1	6.6	7.2	5.1	1.4	1.1	W.
March, ...	1.1	3.4	5.1	4.9	8.4	6.2	1.0	0.9	W.
April, ...	3.0	4.5	4.4	6.2	8.0	5.0	1.4	1.5	W.
May, ...	2.8	3.7	7.0	6.0	4.7	3.0	2.8	1.7	S.
June, ...	1.4	4.6	5.9	5.2	6.6	3.5	1.5	1.2	W.
July, ...	1.2	3.2	4.2	7.2	7.5	4.0	1.7	1.5	W.
August, ...	1.0	3 5	5.8	5.6	5.1	4.0	1.5	1.0	S. W.
September, ...	1.8	4.5	3.6	5.6	5.7	4.8	2.8	2.6	W.
October, ...	1.0	2.2	2.7	9.9	6.6	8.0	2.8	1.2	S. W.
November, ...	1.2	2.8	2.6	4.6	8.0	5.9	2.2	1.7	W.
December, ...	1.5	1.2	3.4	4.0	7.5	8.0	2.9	1.9	N. W.
Year, ...	16.0	38.4	52.8	74.0	81.0	63.6	24.4	17.2	W.

MEAN YEAR IN ANTAGONISTIC ORDER.

Course of Wind.	Days.	Course of Wind.	Days.	Preponderance.	Days.
IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.					
East,	16.0	West,	81.0	West over East,	65.0
South-east,	38.4	North-west,	63.6	N. W. " S. E.,	25.2
South,	52.8	North,	24.4	South " North,	28.4
South-west,	74.0	North-east,	17.2	S. W. " N. E.,	74.0
IN FOUR DIRECTIONS, OR QUADRANTS.					
South-east,	72.8	North-west,	116.3	N. W. " S. E.,	43.5
South-west,	140.9	North-east,	37.4	S. W. " N. E..	103.5
IN SEMI-CIRLES.					
Eastern,	110.2	Western,	257.2	W. over E.,	149.0
Southern,	213.7	Northern,	153.7	S. " N.,	60.0

TABLE VIII.—FORT HOWARD—GREEN BAY.

Mean Monthly Prevalence of the Wind for Nine Years, 1828–'30.

Months.	E.	S. E.	S.	S. W.	W.	N. W.	N.	N. E.	Prev. Winds.
January, ...	0.2	0.1	4.0	13.5	2.5	3.1	2.0	7.0	S. W.
February, ...	0.6	0.1	3.8	10.7	2.9	1.3	3.7	5.1	"
March, ...	1.4	0.9	3.5	9.0	2.9	1.2	2.1	9.9	N. E.
April, ...	0.4	0.5	2.7	10.1	2.4	1.1	4.1	10.8	"
May, ...	0.7	0.6	5.4	9.0	1.0	0.7	2.4	11.3	"
June,.........	0.7	1.3	2.8	12.1	2.9	1.8	2.2	9.1	S. W.
July, ...	0.6	0.7	4.4	10.1	2.7	0.9	0.9	8.3	"
August, ...	1.1	1.9	3.3	10.2	2.6	1.7	1.8	8.3	"
September, ...	1.1	1.3	4.1	7.2	3.0	3.2	2.7	4.9	"
October, ...	1.1	1.9	5.4	10.0	3.0	1.9	2.3	5.3	"
November, ...	1.0	0.5	4.0	9.3	3.2	2.7	2.7	6.5	"
December, ...	0.7	0.9	5.1	12.5	2.9	3.7	2.0	3.1	"
Year,.......	9.6	10.7	48.5	123.7	32.0	23.3	28.9	89.6	S. W.

MEAN YEAR IN ANTAGONISTIC ORDER.

Course of Wind.	Days.	Course of Wind.	Days.	Preponderance.	Days.
IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.					
East,	9.6	West,	32.0	West over East,	22.4
South-east,	10.7	North-west,	23.4	N.W. " S. E.,	12.7
South,'	48.5	North,	28.9	South " North,	19.6
South-west,	123.7	Northeast,	89.6	S. W. " N. E.,	34.1
IN FOUR DIRECTIONS, OR QUADRANTS.					
South-east,	39.7	North-west,	53.8	N. W. over S. E.	14.1
South-west,	163.9	North-east,	108.8	S. W'. " N. E.	55.1
IN SEMI-CIRCLES.					
Eastern,	148.5	Western,	217.7	W. over E.,	69.2
Southern,	203.6	Northern,	162.6	S. " N.,	41.0

TABLE IX.—FORT BRADY—SAULT STE. MARIE.

Mean Monthly Prevalence of the Wind for Six Years, 1823–'30.

Months.	E.	S. E.	S.	S. W.	W.	N. W.	N.	N. E.	Prev. Winds.
January, ...	4.0	7.3	2.0	2.5	4.0	5.5	2.2	2.5	S. E.
February, ...	3.5	6.5	1.5	2.3	5.0	5.3	1.8	2.2	"
March, ...	2.2	9.3	2.7	1.8	4.3	6.3	2.0	1.8	"
April, ...	3.7	7.6	1.6	3.3	6.7	5.2	0.8	1.0	"
May, ...	4.0	6.7	0.8	2.5	6.3	7.2	1.2	2.3	"
June,.........	3.7	5.5	2.0	2.3	6.2	4.8	1.5	2.3	W.
July,.........	1.5	3.7	2.0	5.7	8.1	5.7	2.0	2.3	"
August, ...	2.2	4.7	1.5	5.3	8.3	4.0	1.8	2.2	"
September, ...	1.7	7.0	3.2	2.6	5.6	5.8	2.2	1.8	S. E.
October, ...	2.3	6.2	2.5	3.3	5.5	6.8	1.8	2.8	N. W.
November, ...	5.8	5.3	3.0	2.8	2.5	5.2	2.8	1.7	N. E.
December, ...	5.5	6.2	2.0	2.8	3.0	6.2	2.0	3.3	N.W.& SE.
Year, ...	40.1	76.0	24.8	37.2	65.5	68.0	22.1	26.2	S. E.

MEAN YEAR IN ANTAGONISTIC ORDER.

Course of Wind	Days.	Course of Wind.	Days.	Preponderance.	Days
IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.					
East,	40.1	West,	65.5	W. over E.,	25.4
South-east,	76.0	North-west,	68.0	S. E. " N. W.	8.0
South,	24.8	North,	22.1	S. " N.,	2.7
South-west,	37.2	North-East,	26.2	S. W. " N. E.,	11.0
IN FOUR DIRECTIONS, OR QUADRANTS.					
South-east,	108.5	North-west,	111.7	N. W. over S. E.	3.2
South-west,	82.4	North-east,	57.2	S. W. " N. E.	25.2
IN SEMI-CIRCLES.					
Eastern,	165.7	Western,	194.1	W. over E.,	28.4
Southern,	190.9	Northern,	168.9	S. " N.,	22.0

SECTION III.

TABULAR VIEWS OF THE WIND AT VARIOUS CIVIL STATIONS.

We come now to observations made by different observers in civil life, most of whom are practical meteorologists, on whom reliance may be placed; but their observations have not been reported on the same plan. In a few instances only do they show the duration of any wind, or its force. We again begin in the South.

TABLE I.—FLORIDA REEF.

Winds at Tortugas Islands, Key West, Indian Key, and Carysford Reef, in 1835.*

The figures denote days.

Place of Observation.	N.	Var. N.N.E.	Trades, N. E. to S. E.: N. E.	E.	S. E.	Var.	Var. S.E. to E.	S.	S. W.	Var. S. & W.	W.	N. W.	Var. N. W.	Var. gen'ly.	Pert. calm.	Total in qr.	Calm & light Winds.
WINTER.																	
Tortugas,	16		32	10	7			6	3		1	12			2	90	26
Key West,	17	1	22	11	13	2	1		2	2	2	13	3	1	1	90	16
Indian Key,	22		13	14	13			8		1	4	14			2	90	27
Carysford Reef,	10		15	16	12			4	6		7	18			2	90	23
SPRING.																	
Tortugas,	4	1	33	14	18	1		5	2	1	1	3			9	92	37
Key West,	10	1	17	24	13	2		3	5	2	5	9	1			92	22
Indian Key,	14		2	20	17			25	2		8	2		1	1	92	33
Carysford Reef,	10		20	15	18			12	5		2	4			6	92	27
SUMMER.																	
Tortugas,			6	11	16			2	3		2	1			4	45	21
Key West,	1	1	4	36	22	2	1	5	4	2	4	4	1	4	1	92	36
Indian Key,	1		3	46	23			7	6		2	1		3		92	38
Carysford Reef,	2		15	21	22			16	7		1	2			6	92	40
AUTUMN.																	
Tortugas,	8		34	15	13	1		1	2		1	7		1	8	91	21
Key West,	11	2	32	18	6	2		1	4	1	1	7	4		2	91	15
Indian Key,	16		19	30	8			3	4		5	5		1		91	20
Carysford Reef,	9		31	15	13			2	7		2	11		1		91	27
RESULTS FOR THE YEAR.																	
Tortugas,	28	1	105	52	54	2		14	10	1	5	23		1	23	319	105
Key West,	39	5	75	88	54	8	2	9	15	7	12	33	9	5	4	365	89
Indian Key,	53		37	110	61			43	12	1	19	22		5	2	365	118
Carysford Reef,	31		81	67	65			34	25		12	35		1	14	365	117

MEAN YEAR IN ANTAGONISTIC ORDER.

Course of Wind.	Days.	Course of Wind.	Days.	Preponderance.	Days.
IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.					
East,	79.2	West,	12.0	E. over W.,	67.2
South-east,	58.7	North-west,	35.5	S.E. " N.W.,	23.2
South,	25.2	North,	38.5	N. " S.	13.3
South-west,	17.8	North-east,	75.2	N.E. " S.W.,	57.4
IN FOUR DIRECTIONS, OR QUADRANTS.					
South-east,	111.0	North-west,	60.7	S.E. over N.W.,	50.3
South-west,	42.4	North-east,	134.0	N.E. " S.W.,	91.6
IN SEMI-CIRCLES.					
Eastern,	245.0	Western,	103.1	E. over W.,	141.9
Southern,	153.4	Northern,	194.7	N. " S.,	41.3

* Extracted from a table in the American Almanac for 1837, by W. A. Whitehead, Esq., the Observer at Key West. The other observers were, Captain H. Thompson, C. Howe, Esq., and Captain J. Walton. Observations made in the forenoon and afternoon of each day, and the results shown by adding the half days together.

TABLE II.—NEW ORLEANS—LOUISIANA.

ME. MO. PREV. OF WIND, FOR THREE YEARS, 1840–'42. BY D. T. LILLIE.

Months.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Force as 1 to 10.
January,......	9.0	2.0	5.7	2.3	5.3	2.3	2.0	2.3	1.39
February,.....	4.0	4.3	5.0	2.3	4.0	3.7	2.3	2.7	2.30
March, ...	4.7	1.3	3.3	10.3	2.3	6.3	1.7	1.7	2.27
April.	2.3	1.0	4.0	4.0	9.7	3.7	2.7	2.7	2.47
May, ...	5.3	0.3	3.7	3.0	8.7	2.3	4.3	3.3	2.37
June, ...	1.7	0.7	2.7	2.0	9.7	4.0	8.7	0.7	2.20
July, ...	2.3	0.3	3.7	1.0	10.0	3.0	6.0	1.7	1.37
August, ...	5.7	2.7	3.3	4.7	5.3	2.7	3.7	3.0	1.38
September,....	6.3	1.3	5.7	3.0	9.3	0.7	2.3	1.3	2.17
October, ...	10.0	0.7	4.7	4.0	6.0	0.7	1.0	4.0	2.10
November, ...	8.3	2.3	4.0	2.3	4.3	2.0	2.3	4.3	2.27
December.	10.0	2.0	6.3	1.3	3.3	2.0	2.7	3.7	1.80
Year,.......	72.6	18.9	52.1	40.2	77.9	33.4	39.7	31.4	4.3 Mean.

MEAN YEAR IN ANTAGONISTIC ORDER.

Course of Wind	Days.	Course of Wind.	Days.	Preponderance	Days.
IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.					
East,	52.1	West,	39.7	East over West.	12.4
South-east,	40.2	North-west,	31.4	S. E. " N. W.,	8.8
South,	77.9	North,	72.6	South " North,	5.3
South-west,	33.4	North-east,	18.9	S. W. " N. E.,	14.5
IN FOUR DIRECTIONS, OR QUADRANTS.					
South-east,	105.2	North-west,	87.7	S. E. over N.W.	17.5
South-west,	92.2	North-east,	81.2	S. W. " N. E.,	11.0
IN SEMI-CIRCLES.					
Eastern,	186.4	Western,	179.9	E. over W.,	6.5
Southern,	197.4	Northern,	168.8	S. " N.,	28.5

TABLE III.—NATCHEZ—MISSISSIPPI.

ME. AN. PREV. OF WIND, FOR 15 YS., 1825 to 1839. BY DR. H. TOOLEY.

Course.	1825	1826	1827	1828	1829	1830	1831	1832	1833	1834	1835	1836	1837	1838	1839	Agg. of Obs.	Mean Year.
E.	77	89	91	92	88	58	65	88	75	84	51	79	124	66	77	1204	80.40
S. E.	132	103	76	64	84	44	54	43	40	39	52	33	66	61	66	957	63.12
S.	80	99	116	132	141	131	110	93	88	149	148	155	119	84	107	1752	116.12
S. W.	88	116	85	68	64	90	54	72	71	96	59	66	123	87	120	1259	83.14
W.	31	31	21	26	26	38	25	25	33	38	31	37	65	53	49	295	19.10
N.W.	54	46	26	11	25	28	31	16	25	20	20	21	4	30	28	430	28.10
N.	95	72	88	116	100	88	94	105	82	144	143	131	173	132	118	1681	112.10
N. E.	58	44	44	41	45	21	19	38	54	56	34	22	37	41	44	628	41.13
Year,	615	600	547	550	573	498	452	480	468	626	538	544	711	554	609	8206	

MEAN YEAR IN ANTAGONISTIC ORDER.

Course of Wind.	Obs.	Course of Wind.	Obs.	Preponderance.	Obs.
IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.					
East,	84.40	West,	19.10	E. over W.,	61.30
South-east,	63.12	North-west,	28.10	S. E. " N.W.,	35.02
South,	116.12	North,	112.10	S. " N.,	4.02
South-west,	83.14	North-east.	41.13	S. W. " N. E.,	42.01
IN FOUR DIRECTIONS, OR QUADRANTS.					
South-east,	161.38	North-west,	93.70	S. E. over N.W..	67.68
South-west,	150.75	North-east,	137.38	S. W. " N. E.,	13.37
IN SEMI-CIRCLES.					
Eastern,	298.76	Western,	244.45	E. over W.,	54.31
Southern,	312.13	Northern,	231.08	S. " N.,	81.05

TABLE IV.—HUNTSVILLE—ALABAMA.

MEAN MO. PREV. OF THE WIND FOR 13 YS. 1829–'42.—BY REV. JOHN ALLAN.

Months.	S.	S. W.	W.	N. W.	N.	N E	E.	S. E	Calm.	P. W.
January, ...	9.69	14.30	4.23	18.07	14.92	8.61	0.61	18.84	2.69	S. E.
February, ...	11.76	16.76	3.61	19.92	13.30	8.53	0.53	10.84	1.69	N. W.
March, ...	15.15	17.07	2.84	21.46	13.38	7.07	0.30	10.61	3.52	S. W.
April, ...	14.43	16.76	4.87	16.61	13.91	7.38	0.84	10.76	4.46	"
May, ...	15.69	18.38	4.23	18.38	9.61	8.00	0.85	12.23	4.61	SW&NW
June, ...	14.07	21.76	5.38	13.23	8.54	7.61	2.07	10.92	4.84	S. W.
July, ...	12.61	20.76	4.07	15.67	8.46	9.38	2.46	12.46	5.23	"
August, ...	11.30	13.00	3.30	17.38	15.00	11.61	2.53	13.38	4.00	N. W.
September,....	9.15	13.15	2.53	12.76	11.53	12.23	3.00	18.84	3.30	S. E.
October, ...	11.07	13.84	3.92	13.53	16.61	9.53	0.76	9.76	5.84	N.
November, ...	13.61	14.61	6.76	18.30	14.30	4.38	1.30	11.53	4.38	S. W.
December, ...	10.61	13.53	2.91	21.23	14.84	6.84	0.46	17.07	2.15	S. E.
Year, ...	149.14	193.92	48.65	206.54	154.40	101.17	15.71	157.24	46.71	

MEAN YEAR IN ANTAGONISTIC ORDER.

Course of Wind.	Obs.	Course of Wind.	Obs.	Preponderance.	Obs.
IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.					
East,	15.71	West,	48.65	W. over E.	32.94
South-east,	157.24	North-west,	206.54	N. W. " S. E.	49.30
South,	149.14	North,	154.40	N. " S,	5.26
South-west,	193.92	North-east,	101.17	S. W " N. E	92.75
IN FOUR DIRECTIONS, OR QUADRANTS.					
South-east,	239.66	North-west,	308.06	N. W. over S.E.	68.40
South-west,	292.81	North-east,	186.22	S. W. " N.E.	106.59
IN SEMI-CIRCLES.					
Eastern,	425.88	Western,	600.87	W. over E.,	174.99
Southern,	532.47	Northern,	494.28	S. " N.	38.19

TABLE V.—CINCINNATI—OHIO.

MEAN MO. PREV. OF THE WIND FOR 6 YS., 1809–'14.—BY DR. D. DRAKE.

Months.	S. E.	S.	S. W.	N. E.	N.	N. W.	E.	W.	Calm	Prev. Winds.
January, ...	6	2	13	8	1	21	3	6	6	N. W.
February, ...	5	1	13	8	1	14	0	5	8	"
March, ...	10	1	16	11	1	10	0	5	4	S. W.
April, ...	7	0	24	10	1	8	1	3	5	"
May, ...	7	1	19	10	0	10	1	4	6	"
June, ...	9	1	23	12	5	7	1	2	3	"
July, ...	6	1	19	11	2	11	1	4	4	"
August, ...	6	1	23	10	1	12	1	1	6	"
September, ...	6	1	23	9	0	8	2	3	3	"
October, ...	9	1	24	6	1	10	2	4	3	"
November, ...	9	3	13	6	1	10	2	7	5	"
December, ...	7	1	11	5	0	15	2	6	9	N. W.
Two Obs. a day,	87	14	221	106	14	136	16	50	62	S. W.

MEAN YEAR IN ANTAGONISTIC ORDER.

Course of Wind.	Obs.	Course of Wind.	Obs.	Preponderance.	Obs.
IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.					
East,	16	West,	50	W. over E.	34
South-east,	87	North-west,	136	N.W. " S.E.	49
South,	14	North,	14	S. " N.	Equal.
South-west,	221	North-east,	106	S.W. over N.E.	115
IN FOUR DIRECTIONS, OR QUADRANTS.					
South east,	102	North-west,	168	N.W. over S.E.	66
South-west,	253	North-east,	121	S.W. " N.E.	132
IN SEMI-CIRCLES.					
Eastern,	223	Western,	421	W. over E.,	198
Southern,	355	Northern,	289	S. " N.,	66

TABLE VI.—HUDSON—OHIO.

MEAN MONTHLY PREVALENCE OF THE WIND FOR THREE YEARS, 1838–'40. BY PROF. LOOMIS.*

The figures denote observations.

Months.	9, A. M. N.	9, A. M. S.	9, A. M. E.	9, A. M. W.	9, A. M. Course.	3, P. M. N.	3, P. M. S.	3, P. M. E.	3, P. M. W.	3, P. M. Course.
March, . . .	54.43	31.75	18.74	85.45	N. 71° 13′ W.	68.81	24.55	18.57	102.47	N. 62° 11′ W.
April, ...	61.51	46.69	39.47	84.78	" 71 53 "	91.86	44.98	25.45	96.48	" 56 35 "
May, ...	38.89	37.78	36.14	76.24	" 88 25 "	70.27	38.02	32.98	80.87	" 56 3 "
June, ...	51.55	49.12	23.58	90.79	" 87 56 "	81.71	45.01	17.93	100.61	" 66 4 "
July, ...	40.56	37.67	22.89	99.19	" 87 50 "	79.55	42.35	16.68	111.86	" 68 39 "
August, . .	43.83	37.20	37.57	79.87	" 81 6 "	72.17	32.90	24.56	87.10	" 57 52 "
September,	36.15	48.70	20.81	84.46	S. 78 40 "	62.10	36.39	25.40	105.57	" 72 13 "
October, . .	35.65	55.74	35.09	97.96	" 72 17 "	57.13	52.32	25.18	116.45	" 86 59 "
November,	25.94	48.93	32.38	102.64	" 71 53 "	38.00	43.26	27.24	103.78	S. 86 4 "
December,	44.58	55.31	32.75	123.34	" 83 15 "	58.07	50.83	25.38	131.58	N. 86 6 "
January, . .	44.63	59.42	38.97	95.89	" 75 26 "	42.57	57.00	29.28	108.88	S. 79 43 "
February, .	42.23	53.88	24.33	99.22	" 81 9 "	55.31	58.27	11.16	123.39	" 88 29 "
Total, . . .	519.95	562.19	362.72	1118.83	S. 86° 48′ W.	777.55	525.88	279.81	1269.04	N. 75° 44′ W.

MEAN YEAR IN ANTAGONISTIC ORDER.

IN SEMI-CIRCLES.

Course of Wind.	Obs.	Course of Wind.	Obs.	Preponderance.	Obs.
Eastern,	5.93	Western,	14.92	W. over E.,	8.99
Southern,	11.49	Northern,	9.28	S. " N.,	2.21

* American Journal of Science, Vol. XLI.

TABLE VII.—MILWAUKIE—WISCONSIN.

ME. MO. PREV. OF WIND FOR 3 YS., 1838–'41. BY I. A. LAPHAM, ESQ., AND W. P. PROUDFIT, M. D.

Months.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Prev. Winds.
January,......	5.0	7.0	2.0	6.3	3.7	20.7	13.3	29.0	N. W.
February,.....	4.0	10.0	2.0	2.7	0.3	18.0	14.3	29.3	"
March,.......	6.0	28.7	6.0	4.3	2.0	19.7	8.7	13.7	N. E.
April.........	1.7	23.0	4.7	17.3	0.3	11.3	2.3	15.0	"
May,.........	3.0	30.3	8.7	10.7	0.7	11.3	4.7	9.7	"
June,.........	7.0	21.7	7.0	17.7	6.7	13.7	2.0	3.3	"
July,.........	3.0	21.7	6.7	10.0	2.0	30.3	4.3	6.7	S. W.
August,......	3.3	26.0	3.7	23.0	2.0	12.7	3.0	13.7	N. E.
September,....	3.0	22.0	2.0	13.0	3.3	17.7	8.7	55.3	"
October,......	0.7	18.0	1.7	19.0	3.0	15.3	5.3	20.3	N. W.
November,....	3.3	7.0	0.0	18.0	0.7	23.7	3.0	28.0	"
December,....	1.3	12.7	0.7	10.3	0.7	21.3	4.7	40.0	"
Year,.......	41.3	238.1	45.2	152.3	25.4	215.7	74.3	224.0	N. E.

MEAN YEAR IN ANTAGONISTIC ORDER.

IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.

Course of Wind.	Obs.	Course of Wind.	Obs.	Preponderance.	Obs.
East,	45.2	West,	74.3	W. over E.,	29.1
South-east,	152.3	North-west,	224.0	N.W. " S.E.,	71.7
South,	25,4	North,	41.3	N. " S.,	15.9
South-west,	215.7	North-east,	235.1	N. E. " S. W.,	22.4

IN FOUR DIRECTIONS, OR QUADRANTS.

South-east,	187.6	North-west,	281.7	N. W. over S. E.	94.1
South-west,	265.5	North-east,	281.3	N.E. " S.W.	15.8

IN SEMI-CIRCLES.

Eastern,	468.9	Western,	547.2	W. over E.,	78.8
Western,	453.1	Northern,	562.1	N. " S.	109.4

TABLE VIII.—ROCHESTER—NEW YORK.

MEAN ANNUAL PREV. OF THE WIND, FOR 13 YS. BY WM. L. WETHERELL.

Year.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Prev. Winds.
1835,.........	18.5	28.0	16.5	27.5	24.5	99.5	92.5	58.0	S. W.
1836,.........	21.0	62.5	5.0	42.5	14.0	106.0	57.5	57.5	"
1837,.........	30.5	35.0	6.0	24.0	19.0	98.5	58.0	94.0	"
1838,.........	35.0	12.0	7.0	17.0	55.0	61.0	32.0	46.0	"
1839,........	38.0	30.5	17.0	11.0	48.0	60.0	99.5	61.0	W.
1840,.........	9.5	36.5	9.0	19.5	21.0	110.0	68.5	92.0	S. W.
1841,.........	50.5	38.5	20.0	16.5	14.5	70.5	75.0	79.5	N. W.
1842,.........	31.0	46.5	12.0	15.0	37.0	71.5	79.5	72.5	W.
1843,.........	27.0	34.5	12.5	30.0	14.0	63.0	88.0	96.0	N. W.
1844,.........	28.0	47.5	12.5	26.5	27.5	52.0	73.5	98.5	"
1845,.........	27.5	19.5	6.0	21.0	20.5	50.5	73.5	146.5	"
1846,.........	23.0	43.5	14.0	38.5	13.5	47.5	75.5	109.5	"
1847,.........	14.0	32.5	8.0	38.5	33.5	68.0	68.0	102.5	"
Mean Year,.	27.2	35.9	11.2	25.2	26.3	73.7	72.4	85.7	N. W.

MEAN YEAR IN ANTAGONISTIC ORDER.

IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.

Course of Wind.	Days.	Course of Wind.	Days.	Preponderance.	Days.
East,	11.2	West,	72.4	W. over E.	61.2
South-east,	25.2	North-west,	85.7	N.W. " S.E.	60.5
South,	26.3	North,	27.2	N. " S.	0.9
South-west,	73.7	North-east,	35.9	S.W. " N.E.	37.8

IN FOUR DIRECTIONS, OR QUADRANTS.

South-east,	43.9	North-west,	135.5	N.W. over S.E.	91.6
South-west,	123.0	North-east,	55.1	S.W. " N. E.	67.9

IN SEMI-CIRCLES.

Eastern,	99.0	Western,	258.5	W. over E.	159.5
Southern,	166.9	Northern,	190.6	N. " S.	23.7

TABLE IX.—TORONTO—CANADA WEST.

RESULTS OF SEVEN YEARS OBSERVATIONS AT THE MAGNETICAL AND METEOROLOGICAL OBSERVATORY, 1841–'47, INCLUSIVE.*

The figures denote observations.

Year.	N. W.	S. W.	S. E.	N. E.	Calm.	Remarks.	Prev. Winds.
1841,.........	794.0	507.0	489.0	688.0	1254.0	12 observ's daily.	N. W.
1842,.........	1134.0	939.0	810.0	896.0	1861.0	12 obs., first half.	"
1843,.........	1254.0	1385.0	881.0	988.0	2940.0	24 " second half.	S. W.
1844,.........	1300.0	879.0	1025.0	672.0	3607.0	24 " daily.	N. W.
1845,.........	1618.0	1375.0	911.0	816.0	2735.0	"	"
1846,.........	1468.0	1211.0	904.0	1053.0	2826.0	"	"
1847,.........	1536.0	1355.0	929.0	969.0	2675.0	"	"
Mean Year,.	1300.4	1093.0	849.6	868.6	2556.6		

MEAN YEAR IN ANTAGONISTIC ORDER.

IN FOUR DIRECTIONS, OR QUADRANTS.

Course of Wind.	Obs.	Course of Wind.	Obs.	Preponderance.	Obs.
South-east,	849.6	North-west,	1300.4	N. W. " S. E.,	450.8
South-west,	1093.0	North-east,	868.6	S. W. " N. E..	224.4
IN SEMI-CIRCLES.					
Eastern,	1718.2	Western,	2393.4	W. over E.	675.2
Southern,	1942.6	Northern,	2169.0	N. " S.	226.4

TABLE X.—MONTREAL—CANADA EAST.

MEAN RESULTS OF 5 YS. OBS. ON THE WIND, FROM 1836 TO 1840 INCLUSIVE. BY J. S. McCORD, ESQ.†

Years.	Westerly, NW., W., SW.	Easterly, N. E., E., S. E.	North.	South.	No. of days observed.
1836,	189.20	46.25	65.85	55.66	357.00
1837,	200.00	32.00	56.50	38.50	327.00
1838,	163.00	32.25	66.75	49.25	311.25
1839,	179.00	83.00	63.50	33.50	359.00
1840.	188.50	71.50	47.50	45.50	353.00
Mean	183.94	51.00	60.02	44.48	341.45
About	54 per cent.	15 per cent.	18 per cent.	13 per cent.	

* From Captain Lefroy.

† Amer. Jour. Science, Vol. III.

TABLE XI.—WINTER ISLAND—ARCTIC REGIONS.

M. Mo. Prev. of Wind for 1 Yr., 1821–2.—By Sir W. E. Parry, R. N.

The figures denote half days.

Months.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Prev. Winds.
January, ...	6	4	4	0	0	0	6	42	N. W.
February, ...	6	2	0	0	0	2	0	46	"
March, ...	8	6	0	2	0	3	2	39	"
April, ...	6	10	4	10	0	10	4	18	"
May, ...	4	12	0	5	0	5	6	34	"
June, ...	5	9	2	15	0	10	4	15	S. E. & N. W.
July, ...	9	7	3	8	2	11	3	11	S. W. & N. W.
August, ...	0	8	2	1	4	20	1	23	N. W.
September, ...	0	6	2	11	6	8	1	21	"
October, ...	4	20	4	9	0	4	0	18	N. E.
November, ...	10	18	2	2	2	4	6	16	"
December, ...	11	2	0	10	0	2	0	37	N. W.
Year, ...	69	104	23	73	14	79	33	320	N. W.

MEAN YEAR IN ANTAGONISTIC ORDER.

IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.

Course of Wind.	Hf. dy.	Course of Wind.	Hf. dy.	Preponderance.	Hf. dy.
East,	23	West,	33	W. over E.	10
South-east,	73	North-west,	320	N.W. " S.E.	247
South,	14	North,	69	N. " S.	55
South-west,	79	North-east,	104	N.E. over S.W.	25

IN FOUR DIRECTIONS, OR QUADRANTS.

South east,	91	North-west,	371	N.W. over S.E.	280
South-west,	103	North-east,	150	N.E. " S.W.	47

IN SEMI-CIRCLES.

Eastern,	241	Western,	474	W. over E.,	233
Southern,	194	Northern,	521	N. " S.,	327

TABLE XII.—IGLOOLIK—ARCTIC REGIONS.

M. Mo. Prev. of the Wind for 1 Yr. 1822–3.—By the same.

The figures denote half days.

Months.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Prev. Winds.
January, ...	14	8	0	6	2	4	0	28	N. W.
February, ...	8	8	0	0	0	2	2	36	"
March, ...	12	2	0	0	0	4	12	32	"
April, ...	8	0	0	2	2	6	6	46	"
May, ...	4	8	0	12	8	9	4	17	"
June, ...	14	4	2	2	4	6	4	24	"
July, ...	6	10	2	9	10	3	2	20	"
August, ...	3	11	2	7	2	4	3	30	"
September, ...	2	8	0	14	0	0	6	30	"
October, ...	4	20	0	12	4	3	0	18	N. E.
November, ...	2	1	0	4	2	5	12	34	N. W.
December, ...	4	8	0	0	0	4	22	24	"
Year, ...	81	88	6	68	34	50	73	339	N. W.

MEAN YEAR IN ANTAGONISTIC ORDER.

IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.

Course of Wind	Hf. dy.	Course of Wind.	Hf. dy.	Preponderance.	Hf. dy.
East,	6	West,	73	W. over E.,	67
South-east,	68	North-west,	339	N. W. " S. E.	271
South,	34	North,	81	N. " S.,	47
South-west,	50	North-East,	88	N. E. " S. W.	38

IN FOUR DIRECTIONS, OR QUADRANTS.

South-east,	88	North-west,	416	N. W. over S.E.	328
South-west,	103	North-east,	132	N.E. " S. W.	29

IN SEMI-CIRCLES.

Eastern,	220	Western,	519	W. over E.,	299
Southern,	191	Northern,	548	N. " S.,	357

TABLE XIII.—FELIX HARBOR—ARCTIC REGIONS.

ME. AN. PREV. OF WIND, FOR 2 YS., 1830 TO 1831. BY SIR JOHN ROSS.*

The figures denote hours.

Years 1830-'31.		N.	W.	S.	E.	N. W.	S. W.	S. E.	N. E.	Calm.	Prevailing Winds.
Jan.	1830,	133.0	20.0	41.0	7.0	292.0	210.0	21.0	33.0	87.0	
	1831,	97.0	41.0	78.0	6.0	232 0	92.0	53.0	16.0	129.0	
	Mean,	115.0	30.5	59.5	6.5	262.0	151.0	37.0	24.5	108.0	North-west.
Feb.	1830,	96.0	17.0	95.0	3.0	5.0	102.0	7.0	166.0	181.0	
	1831,	47.0	42.0	112.0	3.0	151.0	170.0	42.0	11.0	94.0	
	Mean,	71.5	29.5	103.5	3.0	78.0	136.0	24.5	88.5	137.5	South-west.
Mh.	1830,	121.0	44.0	23.0	14.0	91.0	118.0	8.0	91.0	234.0	
	1831,	17.0	61.0	113.0	16.0	141.0	132.0	34.0	25.0	205.0	
	Mean,	69.0	52.5	68.0	15.0	116.0	125.0	21.0	58.0	219.5	South-west.
Apr.	1830,	58.0	49.0	30.0	13.0	158.0	151.0	33.0	178.0	50.0	
	1831,	105.0	32.0	62.0	20.0	286.0	73.0	31.0	51.0	61.0	
	Mean,	81.5	40.5	46.0	16.5	222.0	112.0	32.0	114.5	55.5	North-west.
My.	1830,	59.0	49.0	56.0	89.0	164.0	93.0	44.0	146.0	45.0	
	1831,	118.0	67.0	24.0	11.0	202.0	68.0	71.0	98.0	85.0	
	Mean,	138.5	58.0	40.0	50.0	183.0	80.5	57.5	122.0	65.0	North-west.
Je. -	1830,	70.0	82.0	38.0	15.0	63.0	128.0	4.0	249.0	71.0	
	1831,	43.0	81.0	71.0	6.0	195.0	202.0	40.0	9.0	73.0	
	Mean,	56.5	81.5	54.5	10.5	129.0	165.0	22.0	129.0	72.0	South-west.
Jy. -	1830,	191.0	43.0	15.0	8.0	136.0	50.0	35.0	159.0	107.0	
	1831,	88.0	25.0	49.0	66 0	117.0	36.0	106.0	189.0	68.0	
	Mean,	139.5	34.0	32.0	37.0	126.5	43.0	70.5	174.0	87.5	North-east.
Aug	1830,	141.0	41.0	51.0	8.0	299.0	46.0	22.0	91.0	45.0	
	1831,	84.0	57.0	56.0	67.0	177.0	77.0	54.0	115.0	57.0	
	Mean,	112.5	49.0	53.5	37.5	238.0	61.5	38.0	103.0	51.0	North-west.
Sep.	1830,	97.0	45.0	87.0	3.0	243.0	212.0	19.0	90.0	24.0	
	1831,	87.0	26.0	49.0	22.0	267.0	75.0	52.0	83.0	59.0	
	Mean,	92.0	35.5	68.0	12.5	255.0	143.5	35.5	86.5	41.5	North-west.
Oct.	1830,	14.0	99.0	55.0	50.0	219.0	145.0	55.0	59.0	50.0	
	1831,	144.0	24.0	76.0	31.0	190.0	91.0	76.0	32.0	80.0	
	Mean,	79.0	61.5	65.5	40 5	204.5	118.0	65.5	45.5	65.0	North-west.
Nv.	1830,	151.0	75.0	64.0	22.0	124.0	62.0	78.0	22.0	122.0	
	1831,	120.0	23.0	75.0	23.0	115.0	31.0	173.0	4.0	156.0	
	Mean,	135.5	49.0	69.5	22.5	119.5	46.5	125.5	13.0	139 0	North.
De. -	1830,	40.0	52.0	121.0	18.0	171.0	98.9	117.0	4.0	123.0	
	1831.	86.0	14.0	30.0	54.0	285.0	9.0	70.0	8.0	188.0	
	Mean,	63.0	33.0	75.5	36.0	228.0	53.5	93.5	6.0	155.5	North-west.

MEAN YEAR IN ANTAGONISTIC ORDER.

Course of Wind.	Hours.	Course of Wind.	Hours.	Preponderance.	Hours.
IN EIGHT DIRECTIONS, OR SEMI-QUADRANTS.					
East,	287.5	West,	554.5	W. over E.	267.0
South-east,	622.5	North-west,	2161.6	N.W. " S.E.	1539.0
South,	735.5	North,	1153.5	N. " S.	418.0
South-west,	1235.5	North-east,	964.5	S.W. " N.E.	271.0
IN FOUR DIRECTIONS, OR QUADRANTS.					
South-east,	1134.0	North-west,	3015.5	N.W. over S.E.	1881.5
South-west,	1880.5	North-east,	1685.0	S.W. " N. E.	195.5
IN SEMI-CIRCLES.					
Eastern,	2819.0	Western,	4896.0	W. over E.	2077.0
Southern,	3014.5	Northern,	4700.5	N. " S.	1686.0

* Second Voyage.

Each of the foregoing tables indicates the relative frequency of different winds at a particular place, but not the length of time they blew, nor their velocity. It shows the oscillatory movements of the atmosphere, with a certain degree of approximative accuracy, but not its progressive motion. To disclose the latter, the duration and velocity, as well as the direction, of each wind should have been observed and recorded. To the scientific meteorologist, seeking to ascertain the direction and force of the progressive motion of the atmosphere, such observations would be indispensable; but to the practical physician, who regards all meteorological phenomena, in reference to the preservation or destruction of health, rather than the advancement of physical science, these tables will not be found without interest and value. Scattered over such a broad extent of country, from Cape Florida to the coasts of the Polar Sea, they show what winds may be expected in different regions, and will thus aid in making such an estimate of their respective climates, as etiology and practical medicine demand. In advising those who are ill, or those who are threatened with diseases which may be accelerated, averted, or cured by climate, an inspection of the tables may prevent a bad recommendation, or suggest a good one; and, thereby, contribute to the great end of all medical prescription.

But I should not disparage the tables in reference to a philosophical history of the winds of the Interior Valley; and will, therefore, indicate some general conclusions which may be legitimately drawn from them, with an outline of the character of the winds of each quadrant, which will make the subjects of the next section.

SECTION IV.

ORDER, RELATIVE PREVALENCE, CHARACTERISTICS, AND EFFECTS OF OUR VARIOUS WINDS.

I. Order.—Our winds, like those of the northern hemisphere generally, change from one point in the horizon to another, in a certain order. From the manner in which the tables are made out, they do not present evidence of this fact; but every observer, in the middle and southern portions of the Valley, is aware of its reality. The common order of mutation is from the left hand to the right, the face of the observer being turned to the south, and the same when his face is directed to the north. Thus a south-east wind will become a south, south-west, west, north-west, north, and north-east wind, without any intervening calm; but the reverse never happens without a calm following on a northern wind; and in that case, if a southern wind spring up, it is properly a new commencement. An easterly wind rarely begins nearer to a true east course than the south-east, and the north-west wind, in veering round, seldom reaches the east. Thus, while the wind often traverses three of the cardinal points of the compass, south, west, and north, it scarcely ever crosses the east. Commencing generally to the south of east, the wind expires before reaching that cardinal point from the north. But we must not overlook another mode of change, which is oscillatory. In this case, the change is in the same plane, which is generally one that passes between the cardinal points. Thus, after the south-east wind has blown for a time, it may, without an intervening calm, be turned into a north-west—rarely the reverse; and a north-east wind may arrest and triumph over a south-west; though it scarcely ever happens that the latter succeeds to the former, without the occurrence of a calm. The antagonism of these winds is much more common. than that of any others. What has been said applies especially to winds that continue for some time. In certain seasons the oscillations of the atmosphere are so diversified and fitful, that in the course of a single day, there will be many sudden changes without any perceptible order.

II. Relative Prevalence.—Around the Gulf of Mexico, near the northern limits of the trade-winds, even as far north as the thirty-second degree, the east wind prevails over the west and some others; but, above that parallel, up to Boothia Felix, within the Polar Circle, it prevails far less than any other. This fact harmonizes with what has just been said, as to the beginning and ending of the various winds of the card; and strongly indicates the east as a zero or minimum point of the compass, from which to commence the enumeration of different winds. Hence, in the summaries attached to most of the different tables, I have placed this wind first, and proceeded round the horizon to the point of departure. A true south or north wind is, also, comparatively rare; though both are more frequent than the east; and, on the northern margin of the continent, the north wind predominates to a decided degree over any other, which blows from a cardinal point. A wind directly from the west, is still rarer than from south or north; but more frequent, as we have seen, than from the east. Taking all the stations together, we find the order of frequency for the entire Valley, beginning with the lowest, to be east, west, north, and south.

But the aggregate of the winds on the cardinal points, bears so small a proportion to those which blow between them, that we are justified in distributing them among the winds of the intervening points, and thus establishing quadrants. This has been done in the supplements to the tables, by dividing the cardinal winds into halves, and uniting them to the winds on either hand. Thus half the east wind is thrown with the north-east, and the other half with the south-east; and so of the south, west, and north winds. We thereby obtain four principal winds, or rather include the whole under four heads; and this, too, without any violation of philosophical propriety; for the winds on the cardinal points are well known to be intermediate in properties, as well as direction, to those with which they are thus associated. The quadrants formed in this manner are, of course, the south-east, south-west, north-west, and north-east.

General Table of the Winds, at Nineteen Stations, Reduced to Quadrants, and Expressed in Percentage.

Groups of Stations.	Stations.	S. E.	S. W.	N. W.	N. E.
Southern Group, N. Lat. 24°—32°, Five Stations.	Florida Reef,	32	12	18	38
	Camp Clinch,	27	36	20	17
	New Orleans,	29	25	24	22
	Fort Jesup,	30	22	21	26
	Natchez,	30	28	17	25
	Southern Mean,	30	25	20	25
Middle Group, N. Lat. 34°—46°, Eleven Stations.	Huntsville,	23	28	29	18
	Jefferson Barracks,	28	28	28	16
	Cincinnati,	16	38	26	19
	Council Bluff,	28	24	28	20
	Fort Armstrong,	26	29	23	21
	Fort Snelling,	20	39	32	10
	Fort Howard,	11	44	15	30
	Milwaukie,	18	26	27	27
	Rochester,	12	34	38	15
	Toronto,	21	26	32	21
	Fort Brady,	30	23	31	16
	Mean of Middle Group,	21	31	28	20
Arctic Circle, N. Lat. 66°—70°, Three Stations.	Winter Island,	12	14	52	21
	Igloolik,	12	14	56	18
	Felix Harbor,	15	24	39	22
	Northern Mean,	13	17	49	20
	Mean of all the Groups,	21	25	32	22

When we look at this condensation of the observations in each table, we see, at once, that the greater part of our winds are but oscillations of the atmosphere, resembling, on a large scale, the land and sea breezes around the Gulf of Mexico, which compensate or balance each other every day and night, and do not imply a progressive motion. Still, such a movement is, no doubt, a reality; but the tables do not afford data for calculating it. We must now introduce the winds of the different quadrants, and examine them separately. This we shall do in the order of the card, and not of their relative prevalence; beginning, therefore, with the south-east and ending with the north-east. If the other mode were adopted, the order, commencing with the least prevalent, would be south-east, north-east, south-west, and north-west; for such, as may be seen in the table of percentage, is their order of prevalence.

III. The South-East Wind.—The winds composing this quadrant make, of the whole, twenty-one per cent., or about one-fifth. In the southern group they make thirty per cent.; in the middle twenty-one; in the northern thirteen. Thus the relative prevalence of the winds of this quadrant diminishes from the Gulf of Mexico to the Arctic Ocean. When the different stations of the southern group are compared with each other, we find a remarkable equality; Florida Reef, the highest (thirty-two), being only five above Pensacola—Cantonment Clinch—(twenty-seven) the lowest. In the middle group, however, the relative prevalence of the winds of this quadrant, at different places, varies much more widely. Thus, at Fort Gibson, according to the Army Register, they make sixty-four per cent., or nearly two-thirds of all that blow, and constitute the prevailing wind of every month of the year. This anomaly is so great, that I have omitted this post in constructing the table of percentage, supposing some error in the observations. Yet there are topographical causes which may give to the atmospheric currents, at that place, an extraordinary amount of south-eastern direction; and, as illustrating the mechanical influence of the surface of the earth, or the course of the wind, they should be mentioned. In connection with them, I will also refer to other geographical and hydrographical conditions, which deflect certain winds from the paths they would otherwise pursue.

First. The Ozark Mountains, from fifteen hundred to eighteen hundred feet high, in the interior of the State of Missouri, constitute a barrier well fitted to arrest the course of the south-west wind; which is reported, in the Fort Gibson table, as being at a lower per cent. than at any other station in the whole interior of the continent. Now, the course of the Arkansas River is to the south-east, through or near the southern side of those mountains; and thus the south and south-west winds are deflected and largely mingled with the true south-east, which explains the anomaly. *Second.* Another anomaly is presented at Cincinnati: the general course of the Ohio River is to the west south-west, and its valley deflects the south-east and south winds from their course, and blending them with the south-west, raises its figure high, while it reduces the south-east correspondingly low; the former amounting to thirty-eight per cent., the latter only to sixteen. *Third.* Council Bluffs, on the Missouri River, the course of which is to the south-east, has a higher per cent. than Jefferson Barracks, Fort Armstrong, or Fort Snelling, on the Mississippi, the course of which is directly from north to south. *Fourth.* At Fort Brady, near Lake Superior, the south-east quadrant rises nine per cent. above the mean of the group—twenty-one; and, therefore, merits attention. The general course of the river, or Strait Ste. Mary, connecting Lake Superior with Lake Huron, by a south-east direction, offers an obvious explanation; which becomes entirely satisfactory when we connect with it the range of high hills, or rather low mountains, seen stretching nearly east and west, on the northern side, or to the summer leeward of the strait. Thus it is, that mountains and valleys deflect the lower currents of the atmosphere, and impose different names on what is essentially the same wind.

Having thus explained the anomalies in this group, and other groups of stations, it may be said, in general terms, that from Cape Florida, where the outer trade-wind is felt, to the Polar Circle, the south-east wind diminishes in its relative prevalence. The manner in which the diminution is effected, I suppose to be this: From the warm surface of the Gulf of Mexico, which is closely pressed, on the west, by the Cordilleras of Mexico, the rarified air arises and flows over the continent toward the Polar Circle. At first these columns have a direction to the north-west; but, as they advance, they gradually lose it for one to the north, and, finally, to the north-east; becoming thus changed into south and south-west winds. This apparent change is, of course, to be ascribed to the diminishing velocity of the earth's surface, as we pass from the torrid to the frigid zone. But there is still another cause for the infrequency of the south-east wind, as we advance to the north. I refer to the Appalachian Mountains. Originating in the State of Alabama, in the thirty-third degree of latitude, and terminating on the coast of Labrador, near the fiftieth, these mountains constitute, between the Interior Valley and the warm Atlantic Ocean, a barrier from two thousand to four thousand feet high, over which the atmosphere of the latter does not often pass; while, far in the north, the tendency of the cold and dense air to flow to the south-east and overspread the surface of the same ocean, is so great, as to arrest the currents which might otherwise set in the opposite direction.

In temperature the south-east wind is always warm, but except, perhaps, near the Gulf, it does not bring the hottest weather; when it prevails in the morning, and veers to the south-west, its temperature is high, and its humidity small; but, if it continue through the day and night, clouds and rain are the consequence; while, in winter, it often precedes or accompanies the deepest snows of the middle parts of the Valley. While this is going on, it generally veers round to the south-west, but is sometimes suddenly arrested by the antagonistic north-west wind; or, if not arrested, is raised into the upper regions of the atmosphere, and lost to the view of the observer. This wind affects the barometer less than some others; never sinking it as low as the south-west, nor raising it as high as the north-west. It never blows a gale in the middle and higher latitudes, nor does it often generate electrical phenomena; but, on the northern shores of the Gulf of Mexico, it does both. It is, indeed, the principal agent in those drivings of the water of the Gulf, which produce deep inundations around the Balize and the city of New Orleans, or roll the waves of the Gulf over Santa Rosa Island into the Bay of Pensacola.

IV. THE SOUTH-WEST WIND.—The winds of this quadrant make twenty-five per cent., or a fourth part of all the winds of the Interior Valley. When we bring those for each station into comparison with the general mean, twenty-five per cent., we do not find the regular decrease, in advancing from south to north, that was found for the south-east wind. On the contrary, high and low per cents. are distributed throughout, apparently without order. Thus Florida Reef (twelve per cent.) and Winter Island (fourteen per cent.) are among the lowest, while Cantonment Clinch (thirty-six per cent.) and Fort Snelling (thirty-nine per cent.) are both high, and nearly equal. The highest of the whole, is Fort Howard, being forty-four per cent., but Toronto, in nearly the same latitude, is only twenty-six per cent. Yet, notwithstanding these and other irregularities, there *is* an order in the relative prevalence of the winds of this quadrant, which may be deduced from their ratios. Thus, the average of the five stations of the southern group is twenty-five per cent.; of the eleven stations of the middle group, thirty-one per cent.; of the three stations of the northern group, seventeen per cent. The numbers twenty-five, thirty-one, and seventeen, express, then, the relative prevalence of the winds of this quadrant, in the hot, the temperate, and frigid zones of the Valley. Thus, it appears that they are preëminently the winds of the middle latitudes of the Valley. This may be explained as follows. In the south, as we have seen, there is a great prevalence of south-west wind; much of this, before it reaches the middle latitudes, assumes, from the diminishing velocity of the earth's surface, a south-west course, and before reaching the polar circle, dies away, or is converted into a west or north-west wind, by the descent of the cold and dense atmosphere of the Rocky Mountains.

But there is another and greater cause of this prevalence, which I shall proceed to set forth. The winds of the south-west quadrant appear in two varieties, the arid, and humid, which must be considered under separate heads.*

1. *The Arid South-West Wind.*—This wind begins in the morning, when the sun has been above the horizon two or three hours; attains its maximum from two to four in the afternoon; and subsides by sunset or soon afterward, when, in general, a dead calm ensues. The common time of commencement, is that morning hour, which has the mean heat of the twenty-four—its greatest velocity generally occurs during the highest heat of the day. It never blows but in fair weather. Its general prevalence is in the early part of spring, throughout the summer, and in early autumn. Yet it is sometimes felt in the depths of winter, when other winds are quiet, but does not then acquire the velocity which it shows in hot weather; and prevails for a much shorter portion of the day. This wind, which so closely resembles the sea breeze of the Gulf of Mexico, does not consist of air brought from a distance, but is a simultaneous and fitful movement of the atmosphere over the surface of the continent, from south-east, south, or south-west, to north, or north-east. Thus, it begins and ends at the same time, under the same meridian; but progressively from east to west, under the same parallel of latitude. There can be no doubt of its immediate dependence on the action of the sun upon the surface of the earth. The facts which have been cited, lead to this conclusion; but, still further, it generally commences as a south-east wind, while the sun is yet east of the meridian, and veers to the south or south-west, with the progress of that luminary. In what manner the solar rays act upon the earth's surface to generate it, does not, to my mind, seem very obvious. Perhaps it is by warming the sides on which the solar rays impinge, of every tuberosity of the ground, and of every object standing upon it, while their opposite sides still retain the temperature of the night. The effect of this warming must necessarily be to rarify the air in contact with the surfaces thus exposed, and produce upward

* Drake's Picture of Cincinnati, 1815.

currents; these being established, the cold air on theunwarmed sides of the same objects, is put in horizontal motion, toward the base of the ascending currents. Thus, two movements are generated; and if we refer to the countless number of inequalities, including hills and forests, which are thus acted on, we may perhaps find in this operation a sufficient motive power for the effect in question. In support of this conclusion, two additional facts may be cited. *First.* It is well known, that when this wind blows with augmented velocity, it often raises light bodies to a considerable hight, indicating apparently, an oblique, upward current. *Second.* It blows chiefly near the surface of the earth, for the clouds (*cumuli*) which form in the atmosphere, more on the days on which this wind prevails than any others, are commonly observed to be at rest.

This dry south-west, is always a wind of high temperature. The days on which it occurs in the cold seasons are comparatively mild and genial. It prevails in the hottest days of summer, when the mercury ranges between 90° and 100°; but cannot be regarded as the cause, so much as the effect, of the great heat; and so far from adding to the heat and debility felt on those days, diminishes both, by promoting evaporation from the surface of the body.

This wind does not, to any great extent, affect the barometer; nor is it attended with any other rain than a thunder shower, which invariably terminates it for the day. On the contrary, it is the principal wind through the long droughts of summer and early autumn, when it prevails over all other winds of the card. In the year 1814, between the 25th of July and the 19th of August—twenty-six days—I saw it prevail on twenty-two days, and a part of three others—the north-west being the wind of one day. Of that period, eighteen days were fair, five cloudy, and three mixed. Six thunder showers were scattered through the twenty-six days. In the whole time, the barometer (uncorrected) oscillated between 29.34 in. and 29.70 in.—range only 36.

During the reign of this wind, we sometimes feel, at evening twilight, a momentary breeze of hot air; but a much more frequent phenomenon is a cool current at that hour or soon afterward, descending by the lateral ravines into a principal valley, where the difference of elevation between the valley and surrounding hills is considerable. This compensating descent of cooler air, analagous to the land breeze of the night along the Gulf of Mexico, suggests that the currents of the day, during the prevalence of our dry south-west, have an oblique direction upward, as already intimated, and are compensated by the descent of colder air, thus presenting a vertical rather than a horizontal oscillation. It is quite obvious, then, that the dry south-west is not a wind of progression. What proportion it bears to the humid variety is not known; but, I am satisfied, that it prevails on a much greater number of days than the latter; and hope some of our practical meteorologists will make their comparative prevalence a subject of observation. Meanwhile we may assert, that it is this variety which gives to the south wind so large a place in the registers kept in the interior or middle latitudes of the continent.

2. *The Humid South-West Wind.*—This variety differs widely from the last. It is not the wind of a single day, but generally continues throughout the twenty-four hours, and often for two or three days. It is an occasional wind, and sets in at any hour of day or night. It sometimes unites itself with the dry south-west, which may be known by a continuance through the night. A turbid and, at length, cloudy state of the atmosphere, never fails to be developed by it; and the clouds are not at rest, but move with a steady velocity in the same direction, with the currents at the earth's surface. Sooner or later, they send down rain, which is often copious and prolonged. In winter, deep snows occasionally fall from them, and sometimes deluges of rain, accompanied, as high up as the forty-fifth degree of latitude or still higher, with thaws and floods. The termination of this series of phenomena is, generally, in one of two modes. *First.* The wind veers to the west or north-west, the rains cease, the clouds are dissipated, the thermometer falls, and the barometer rises: Or, *Second*, an antagonizing north-east wind arrives, and the clouds are driven back, still, however, neotinuing to be dissolved in rain; the sky, at length, becomes fair, and the north-east, as a cool and comparatively dry wind, continues to blow for one or many days, when a calm succeeds. The heat of this wind is generally high; but the rain it brings cools the air, and refreshes all organized nature. In many instances it takes on the velocity of a stiff breeze; and, occasionally, when it impinges against a north-west wind, a hurricane is generated. Electrical phenomena often attend its commencement, but, in general, are not of the most violent kind.

Unlike the arid south-west, this wind always sinks the barometer. Indeed, the minima of that instrument are connected with it. This I have verified by the inspection of tables formerly kept by myself; and Professor Ray has made, as he informs me, the same observation.

The humid south-west is unquestionably a wind of progression—a current passing from the warm surface of the Gulf, where it has become saturated with moisture, toward the polar regions. But it does not always preserve the same direction. In the lower latitudes it very commonly has a south course, and sometimes a south-east; in the middle latitudes it varies from south to west, still preserving its characteristic properties. It is even sometimes so deflected, as to become more or less of a north-western wind; but, when this happens, the rain soon ceases, a true north-wester sets in, and the clouds are dissipated.

V. WINDS OF THE NORTH-WEST QUADRANT.—According to the table of percentage, the amount which represents these winds for the entire Valley, is thirty-two per cent.; making them nearly one-third of the whole. In the southern group, they only reach twenty per cent, or one-fifth; in the middle group twenty-eight, or more than a quarter; in the arctic forty-nine, or almost one half. We see, then, that these winds increase in prevalence as we go from south to north, at a still higher ratio than the antagonizing winds of the south-east quadrant, decrease through the same extent of continent; and their increase, if we compare the groups by their percentage, and their mean latitudes, makes a near approach to uniformity. The north-west wind presents, like the south-west, two varieties, distinguishable chiefly by their duration.

The *transient* north-west is the wind which attends or follows our thunder showers; but its occurrence, in connection with them, is not invariable; for some of them are accompanied by a south-west wind, and are not succeeded by a north-west. When this wind does not follow, the storm is generally repeated; and, this occasionally happens day after day, at last winding up with a stiff north-west breeze. When the first movements of the storm are from the north-west, it is not often repeated on the same day or night. It was a correct suggestion of Volney,* that this wind consists of air which descends from the higher regions. It is always comparatively cold. It sinks the thermometer, raises the barometer, and dissipates the clouds, giving a bright sky. Thus it completes the vertical oscillation of the atmosphere, begun by the ascent of heated air, and restores the equilibrium.

The other, and more *permanent* variety, is not a wind of diurnal oscillation, and must be considered in reference to its efficient causes.

1. As the atmosphere moves westwardly between the tropics, and, as the table of percentage shows, to some degrees of latitude, above the northern tropic, there must, in the higher latitudes, be a compensating movement to the eastward.

2. In the south the heated Caribbean Sea and the Gulf of Mexico, lie east of and near to high ranges of mountains, the cold and dense atmosphere of which readily slides down to the surface of these warm seas, whose atmosphere is continually rising and flowing off toward the pole.

3. As these currents traverse our Valley, they sink the barometer, as already stated, and thus invite upon it the colder air of the Rocky Mountains to its west.

4. The Atlantic Ocean, from the West Indies to New Foundland, is warmed by the Gulf stream, and also by the action of the sun, to a far greater depth in summer, than the interior of the continent; and, therefore, in winter has a much higher surface heat, with a correspondingly greater rarefaction of the atmosphere resting over it, than of that resting over the continent, especially its western Alpine regions; consequently, there is a tendency in the atmosphere of the latter to flow down upon the former. Indeed, there can, for the western side of the Atlantic basin, be no other compensating supply, than that afforded by the adjacent continent.

Under the influence of these causes, this variety of our North-west is made a wind of progression, and often blows for several days in succession, while the other variety commonly endures for a few hours only.

The greatest hights of the barometer are occasioned by this wind. The extreme oscillations of that instrument are produced by the sudden alternation of this with the humid south-west. On the afternoon of the 1st of February, 1814, under the influence of this wind, the barometer, at Cin-

* View of the Soil and Climate of the United States.

cinnati, sunk to 28.93; a change of weather took place, accompanied by a north-west wind, and, on the morning of the 4th, the barometer stood at 29.95, having risin more than an inch. On the 10th, 11th, and 12th of May, of the same year, a southerly wind prevailing, the barometer, for three days, ranged between 28.80 and 29.00; the north-west wind then set in, and for the next three days it ranged between 29.30 and 29.60.

Coming from a higher latitude and greater elevation, this wind is always relatively cold. The sudden depressions of temperature with which the people of the middle latitudes of the Valley are so familiar, are produced by this wind. The extreme depressions of the thermometer do not, in general, happen while the wind is still blowing, but in the calm which follows; and the greatest cold, as yet recorded in the Valley, occurred during a calm. Thus, at Fort Reliance, in N. Lat. 62° 46′, where for a week, in January 1834, the mercury ranged between —56° and —70°, two-thirds of the observations are reported calm. The day before and the morning of the last extraordinary depression, were entirely calm.*

When the north-west and the humid south-west winds impinge against each other, the former at length predominating, it seems, to those who have not observed the antecedent phenomena, to bring rain or snow; but the precipitation is from the deflected south-west currents. The north-west is, in fact, essentially a dry and a drying wind, except where it blows over the northern lakes, the axis of which lies in its course between the forty-first and forty-eighth parallels. The causes of this dryness are easily understood. The low temperature of the atmosphere, resting on the Rocky Mountains, occasions the deposit of a large portion of its vapor in the form of snow; and when it descends to traverse the great inclined plain, which stretches from their base to the Mississippi River, it rolls over the dryest part of the continent. In descending this broad and treeless desert, where but few objects rise up to retard its progress, it necessarily acquires great force; and often becomes, indeed, the swiftest wind of the Valley, if we except that which constitutes our hurricanes. Hence, on the prairies of Missouri, Iowa, Wisconsin, and Illinois, in a winter night, it is sometimes so piercing, as to destroy both man and beast when long exposed; although the latitude might not suggest the possibility of such a catastrophe. We must now study it in the southern latitudes.

We have seen that the winds of the north-west quadrant, make a fifth or twenty per cent. of those which blow around the Gulf of Mexico. This is but four-fifths of the north-east and south-west, and but two-thirds of the south-east; yet it is greater than, at first view, might have been expected. A clearing up of the difficulty may be found in the distinction which has been drawn between the *transient* and *permanent* winds of this quadrant. A large part of the winds which make up the twenty per cent. of the table were of the former variety: mere local breezes, following the numerous thunder showers of that region. The other variety, however, does prevail

* Captain Back's Narrative.

around the Gulf, even down to the Tropic of Cancer. In the states which rest on the Gulf, it occurs in the colder parts of every year; but is less violent and rigorous on the eastern than the western side of that basin. In Texas, and south of that state in the *tierra caliente* of Mexico, this wind is frequently of great force; and so low in temperature, as to prove exceedingly chilling. It is not, however, until it reaches the smooth surface of the Gulf, the rarified atmosphere of which has contributed to its production, that it attains its greatest momentum. It then traverses the northern segment of the Gulf, and drives the waves upon the coasts and reefs of Cape Florida; on the recession of which it is not uncommon to find many fish that have perished apparently from the change of temperature in the shallow waters.* The currents which make up this wind are, by the inhabitants around the Gulf and the seamen who navigate it, called the Northers—*los Nortes*. Humboldt has given the following account of their prevalence at Vera Cruz: †

"The north winds (*los nortes*), which are north-west winds, blow in the Gulf of Mexico from the autumnal to the spring equinox. These winds are generally moderate in the months of September and October; their greatest fury is in the month of March; and they sometimes last to April. Those navigators who have long frequented the port of Vera Cruz, know the symptoms of the coming tempest as a physician knows the symptoms of an acute malady. According to the excellent observations of M. Orta, a great change in the barometer, and a sudden interruption in the regular recurrence of the horary variations of that instrument, are the sure forerunners of the tempest. It is accompanied by the following phenomena. At first a small land wind (*terral*) blows from the west-north-west; and to this *terral* succeeds a breeze, first from the north-east and then from the south. During all this time a most suffocating heat prevails; and the water dissolved in the air is precipitated on the brick walls, the pavement, and iron or wooden balustrades. The summits of the Pic d'Orizaba and the Cofre de Perote, and the mountains of Villa Rica, particularly the Sierra de San Martin, which extends from Tustla to Guasacualco, appear uncovered with clouds, while their bases are concealed under a vail of demi-transparent vapors. These cordilleras appear projected on a fine azure ground. In this state of the atmosphere the tempest commences, and sometimes with such impetuosity, that before the lapse of a quarter of an hour it would be dangerous to remain on the mole in the port of Vera Cruz. All communication between the city and the castle of S. Juan d'Ulloa is thenceforth interrupted. These north wind hurricanes generally remain for three or four days, and sometimes for ten or twelve. If the north wind change into a south breeze, the latter is very inconstant, and it is then probable that the tempest will recommence; but if the north veers to the east by the north-east, then the breeze or fine weather is durable."

It will have been remarked that, according to Humboldt, the northers

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*MS. of the late Commander Johnston, United States Navy.

†Political Essay on New Spain, Vol. I, Book I, Chapter 3.

rage with the greatest fury in the month of March. This does not arise from the occurrence of the vernal equinox in that month, for, according to the same philosopher, they are generally moderate in the September, the month of autumnal equinox. Their violent prevalence in early spring, is to be ascribed to the difference between the temperature of the Gulf and the mountains having at that time reached its maximum; while in autumn they vary much less in that respect.

We must, in conclusion, ascend to the group of northern stations, lying between the sixty-sixth and seventieth degrees of latitude. The winds of this quadrant make, in that desolate region, about one-half, or forty-nine per cent. of all that blow. An inspection of the monthly tables of Parry and Ross shows that, like the other winds, these are exceedingly variable; yet they indicate a progressive motion of the atmosphere from north-west to south-east. The winds of the northern semi-circle there amount to seventy per cent.—of the southern to thirty. The Arctic Circle is, in fact, almost at the terminating point of the tropical currents, which are flowing toward the pole, and the gelid air of the frigid zone is there on its way toward the equatorial regions. But, although moving southerly, and by the increasing velocity of the earth's surface, it might be expected to flow toward the south or the south-west, it rolls most of the time to a point east of south. This, doubtless, arises from the attractive influence of the Atlantic Ocean, which is known to maintain, in the same northern latitudes, a temperature far higher than the adjoining continent.

VI. Winds of the North-East Quadrant.—An inspection of the table of percentage shows the winds of this quadrant to be less than those of the south-west and north-west quarters, but a fraction greater than the south-east; the former being twenty-two, the latter twenty-one per cent. of all that blow. When the groups of stations are compared, we find their amounts more uniform than those which represent the other winds. Thus, in the southern, the per cent. of prevalence is twenty-five, while that of the south-east is thirty; in the middle it is twenty, that of the south-east being twenty-one; in the northern twenty, that of the south-east thirteen per cent. Hence, both winds decrease in going north, but the south-east at the greater ratio, the difference between the amount of its southern and its northern per centage being seventeen, while the corresponding difference in the north-east percentage is only five. In the southorn group the north-east wind is equal to the south-west; in the middle far less—in the northern much more. Compared with the north-west, it is greater in the southern group, much less in the middle, and far less in the northern. It appears, then, that this wind in the southern latitudes consists, in part, of currents moving south, which, by mingling with the outer trade-winds, are deflected toward the west. In fact, the winds of this group consist of air which is gravitating from the frigid zone in compensating currents. They are not divisible, like the south-west and north-west, into transient and more permanent. The length of time it blows, without ceasing, is various; but, in the middle latitudes, it seldom terminates in twenty-four hours; and sometimes continues for a week. In many instances it is preceded by a north-west and north wind, when it generally sinks the barometer, and raises the thermometer a little. At other times it is preceded by a south-west wind, and then the barometer rises and the thermometer falls; but, under the influence of this wind, the cold is never intense. On the Gulf it is apt to blow as a destructive gale, but over the continent it never attains to that velocity. It is essentially a humid wind, as appears from its not dissipating the clouds, which are borne on the south-west wind, as rapidly as they are dissolved when traversed by the north-west. It often precedes and accompanies rain, but this arises from its meeting the humid south-west. The rain or snow is, then, at the beginning of the north-easter; and it often continues for several days afterward, with a clear sky; still, even then it produces a sensation of rawness not felt under a north-west wind of the same temperature, which sufficiently indicates its greater humidity.

In conclusion, it may be said of this wind, that it is characterized by its intermediate qualities; being not so cold, dry, heavy, and rapid as the north-west; nor so warm, humid, light, and electrical as the south-west and south-east—with less of a fitful character than belongs to either.

VII. The Winds of the Quadrants reduced to Semi-Circles.—The object of this induction is to obtain a knowledge of the relative prevalence of our eastern, western, southern, and northern winds. If the observations contained in the monthly tables had been so made, as to show the duration and velocity of every wind, a condensation of this kind would indicate the direction and rapidity with which the whole atmosphere of the Valley is moved. As it is, this generalization affords but the remotest approximation to such a result, yet, it answers a different end. It shows us the comparative frequency of the eastern, western, southern, and northern winds in the different latitudes of the Valley. In forming such a table, the winds that blow on the cardinal points which divide a semi-circle, might be left out. For example, in determining the amount of easterly and westerly winds the south and north winds might be omitted, as belonging to neither. To divide each of those winds, however, and add their halves to the eastern and western, maintains the same relation between the two latter, and as this was done in forming the quadrants, I shall continue it here, using the percents which represent them, in constructing the following table.

TABLE SHOWING, PERCENTUM, THE RELATIVE FREQUENCY OF THE WINDS, CONDENSED INTO SEMI-CIRCLES.

SOUTHERN GROUP.						
Eastern:	S. E.	30 +	N. E.	25 =	55	per cent.
Western:	S. W.	25 +	N. W.	20 =	45	"
Southern:	S. E.	30 +	S. W.	25 =	55	"
Northern:	N. W.	20 +	N. E.	25 =	45	"
MIDDLE GROUP.						
Eastern:	S. E.	21 +	N. E.	20 =	41	per cent.
Western:	S. W.	31 +	N. W.	28 =	59	"
Southern:	S. E.	21 +	S. W.	31 =	52	"
Northern:	N. W.	28 +	N. E.	20 =	48	"
NORTHERN GROUP.						
Eastern:	S. E.	13 +	N. E.	20 =	33	per cent.
Western:	S. W.	17 +	N. W.	49 =	66	"
Southern:	S. E.	13 +	S. W.	17 =	30	"
Northern:	N. W.	49 +	N. E.	20 =	69	"
MEAN OF THE WHOLE.						
Eastern 43—Western 57—Southern 46—Northern 54.						

By the last line of this table we perceive that, taking the Interior Valley as a whole, the western winds prevail over the eastern in the proportion of fifty-seven to forty-three; and the northern over the southern in the proportion of fifty-four to forty-six. But when we examine the different groups of stations, there is considerable diversity. Thus, in the southern, up to the thirty-second degree of north latitude, the eastern winds prevail over the western, in the proportion of fifty-five to forty-five; and the southern over the northern as fifty-five over forty-five. In the middle group, from the thirty-second to the forty-sixth parallel of latitude, the western winds prevail over the eastern as fifty-nine to forty-one—the southern over the northern as fifty-two to forty-eight. In the northern group, about the Arctic Circle, the western exceed the eastern in the proportion of sixty-six to thirty-three, that is, are twice as frequent; and the northern rise over the southern in the proportion of sixty-nine to thirty, or more than twice as much. All these results conform to principle; for, in the south, the greater velocity of the earth's surface gives to the air which has glided down from the north, an apparent direction to the west, making it the highest of the whole; and, as much of it is rising and flowing off toward the pole, the southern winds predominate over the northern. In the middle section, these currents are largely turned round toward the east, and give a preponderance to the western winds; and the dry or arid south and south-west winds, which are generated by the action of the sun on the surface of the earth, raise the proportion of southerly winds, so as still to keep it above the northerly, notwithstanding they have increased. Finally, in the distant north, we arrive at a region whence the air is departing to the south, chiefly by way of the Atlantic Ocean; and, there, the western winds exceed the eastern, by one hundred per cent. of the latter, and the northern surpass the southern in a still higher proportion—all of which might have been expected.

VIII. Calms.—Nearly all our observers have omitted calms. Of four thousand two hundred forenoon and afternoon observations on the common vane, made by myself, at Cincinnati, from 1809 to 1814 inclusive, three hundred and sixty-eight, or nearly nine per cent., were calm. The calmest month was December—the windiest June, September, and October—equal.* Of eighteen thousand three hundred and thirty-eight hourly observations, continued through night and day, in the years 1841, '42, at Toronto, five thousand and seventy-eight were calm; making nearly twenty-eight per cent.† The calmest month was August—windiest April. Of seventeen thousand six hundred and thirteen hourly observations, at Felix Harbor, under the direction of Captain Ross, in 1830, '31, two thousand one hundred and twenty were calm, making about thirteen per cent. The windiest month was September—the calmest March.‡ The difference between the two northern stations and Cincinnati, may be ascribed, in part at least, to the nocturnal observations at the former stations, for it is well known to every inhabitant of the Valley, that the wind blows more in the day than night; and that the number of calm nights, in the course of the year, is much greater than of calm days. Among our winds there is, however, in this respect, considerable diversity. The land breeze of the evening, on the shores of the Gulf of Mexico, is succeeded by a morning calm. The dry south and south-west wind is followed, generally, by a calm night; and the west or north-west wind, which succeeds an afternoon thunder-storm, commonly subsides in a few hours, and is followed by a calm. Even when these winds are of a more permanent character, they often cease or greatly abate at the going down of the sun; but, at other times, continue with unmitigated violence throughout the night. The humid south-east, south, and south-west winds, blow through the night as well as the day; and the north-east wind generally continues of the same force day and night. A dead calm often precedes a thunder-shower, and greatly increases the feeling of heat and exhaustion which ordinarily precede that phenomenon. A perfect and long-continued calm, such as is met with at sea, seldom occurs in our Valley; and, hence, in all our registers, the course of the wind, is found noted for a part, at least, of almost every day of the year. Calms are pleasant after we have been exposed, for some time, to high winds; but their long continuance is, in reference both to health and comfort, undesirable.

IX. Good and Evil of our Winds.—The arid south-west, in the heats of summer, fans and cools the body. The humid, brings us clouds, which intercept the fiery beams of the sun, and refresh all organized nature with rain; but in the latter part of winter, and in early spring, it brings forth vegetation before the proper time; and by leading the imprudent to cast off

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* Picture of Cincinnati.

† Observations made at the Mag. and Met. Observatory, p. 96.

‡ Second Voyage.

their winter clothing too soon, subjects them to catarrhs, vernal intermittents, and various phlegmasiæ. The north-west wind terminates our settled rains, brings a fair sky, and invigorates the body, languishing under the heat of summer; but it may be the exciting cause of autumnal fever, and when its blows fiercely after hot weather, generates a high degree of phlogistic diathesis. The north-east wind, meeting the humid south-west, acts as a cooler, and generates rain; but its direct effects on the body are unfavorable, as it chills the surface, reproduces paroxysms of dyspepsia, generates catarrh, croup, and bronchitis, excites autumnal and yellow fever, in the predisposed, and awakens intermittents in the spring, where they have prevailed in autumn. Calms permit the exhalations from foul localities to accumulate in the atmosphere which rests over them; but all winds operate to disperse and dilute them with purer air; in doing which they may promote the salubrity of one spot, and diminish that of another. On the whole, the oscillations of the atmosphere are indispensable to a proper equilibrium of its various qualities, and to its beneficial influences on the growth and health of both plants and animals; and, although they often do mischief to both, their utility greatly predominates.

CHAPTER IV.

AQUEOUS METEORS.

SECTION I.

RAIN AND SNOW.

I. Tabular View.—Following out the method pursued in the discussion of the temperature, atmospheric pressure, and winds of the Interior Valley, I have arranged into a general table, the results of observations made at different places, on the quantity of atmospheric water, which annually falls in the form of rain and snow. The table embraces thirty-two stations, lying between and including Key West in the Gulf of Mexico, and Toronto on the north side of Lake Ontario; and, therefore, extending through twenty degrees of latitude. At eighteen of the stations, the mean quantity of rain in each month is given; at the remaining fourteen, that of the year only. The stations have been thrown into groups which represent different regions. The quantity falling in the polar regions is unknown to me. The observations made at a number of the stations are altogether reliable; but there is reason to fear that many of the others are but approximations to the truth; nevertheless, it seems better to use than reject them, as an error of an inch or two, in the year, is not of great moment in this branch of our inquiry. I presume that, in all cases, the quantity of melted snow is included under the head of rain.

TABLE I.—AVERAGE QUANTITY OF RAIN AND SNOW AT THIRTY-TWO PLACES.

ARRANGED IN GROUPS.

Places.	Years.	Dates.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Year.	Authorities.
GROUP I. *Isls. of Gulf of Mexico.*																
Key West, . . .	6	1833–38	1.526	1.054	1.447	1.132	5.256	2.681	2.593	3.723	4.445	32.95	2.460	1.171	30.783	Whitehead.
GROUP II. *On N. Arc of Gulf, Lat. 32°.*																
New Orleans, .	3	1840–42	4.102	5.189	4.293	3.970	2.311	3.182	5.703	4.466	3.918	3.926	4.218	5.926	51.204	Lillie.
Mobile, ...	2	1841–42	8.890	5.075	5.862	4.952	3.428	5.055	4.357	8.587	4.677	2.647	6.576	4.308	66.915	North.
St. Francisville,	5		4.080	3.520	3.960	7.290	5.300	3.760	6.370	2.950	3.150	3.670	5.150	6.070	55.270	Barton.
Fort Jesup, . .	4														47.430	Met. Reg. U. S. A.
Natchez, ...	6	1840–47	4.710	5.490	4.820	5.700	4.730	5.720	6.570	3.070	5.550	2.470	4.890	6.400	60.120	Tooley.
														Mean	56.188	
GROUP III. *Along and West of Mississippi, Lat. 32° to 45°.*																
Fort Towson, .	3														46.730	Met. Reg. U. S. A.
Fort Smith, . .	3														35.640	"
Fort Gibson, . .	3														30.640	"
St. Louis, ...	12	1837–48	2.040	1.950	3.160	3.810	4.900	6.660	3.650	4.040	2.290	3.500	3.010	2.530	39.670	Engelmann.
Ft. Leavenworth	3														32.680	Met. Reg. U. S. A.
Fort Crawford,	3														29.540	"
Fort Snelling, .	3														30.320	"
														Mean	35.031	

GROUP IV. *East of the Mississippi, and S. of N. Lakes, from Lat. 32° to 41°.*															
Huntsville, . . .	12	1831–42	5.803	4.715	5.886	5.025	3.967	5.121	4.589	4.868	3.492	2.829	3.672	4.911	54.878	Allan.
Nashville, ...	5	1840–44	5.006	3.984	4.904	5.200	4.944	4.996	4.410	5.062	5.134	4.392	3.970	2.000	55.002	Hamilton.
Portsmouth, . .	15	1827–41	3.000	2.900	2.900	3.200	3.900	4.500	4.400	2.700	2.400	2.900	2.800	2.600	38.200	Hempstead.
Cincinnati, . . .	13	1835–47	3.190	3.010	3.270	3.500	5.120	5.750	4.280	4.580	3.420	3.640	3.720	3.720	47.200	Ray.
Marietta, ...	18	1826–43	2.760	3.210	2.860	3.310	3.890	5.040	4.190	3.760	3.120	2.960	3.040	3.150	41.290	Hildreth.
Steubenville, . .	10	1833–42	2.358	2.139	3.204	2.684	3.506	3.706	3.456	3.740	2.908	2.380	2.869	2.380	35.332	Marsh.
													Mean	45.317	
GROUP V. *Around the Northern Lakes.*															
Hudson, ...	2	1839–40	2.078	2.329	5.202	2.707	3.043	4.647	3.196	3.509	2.881	2.648	2.520	1.922	36.682	Loomis.
Fredonia, ...	7		2.280	1.370	2.560	2.020	3.220	3.460	2.850	2.490	4.500	3.720	3.010	3.040	34.530	New York Repts.
Middlebury, . .	17														30.470	"
Mexico, ...	7		2.340	2.040	2.740	1.410	1.790	2.570	3.100	2.160	2.700	4.020	2.970	3.320	32.160	"
Onondaga, . . .	16														31.400	"
Pompey, ...	17														29.460	"
Rochester, . . .	13	1835–47	2.000	1.690	1.760	2.200	3.060	3.180	2.830	2.770	7.150	3.550	2.730	2.000	34.920	Wetherell.
Oneida Conf., .	19														38.340	New York Repts.
Lowville, ...	7		2.240	1.140	1.660	1.270	3.110	2.720	4.230	2.390	2.370	2.970	3.950	1.200	28.240	"
Toronto, ...	9	1840–48	2.466	0.916	1.636	2.461	2.917	3.375	3.803	2.864	4.610	2.812	3.229	1.709	32.798	Mag. and Met. Ob.
Ft. Winnebago,	3														31.880	Met. Reg. U. S. A.
Ft. Howard, . .	4														38.830	"
Ft. Brady, . . .	3														31.890	"
													Mean	33.200	

II. Remarks on the Year.—The first thing which strikes the eye, when it rests on the foregoing table, is the unequal amount of rain, or rain and snow, in the different regions of the Valley. The smallness of the amount at Key West, 30.783 inches, will perhaps excite astonishment in those who are accustomed to think, that as we go south, the rains become more copious. But we must recollect that Key West is a small island, which scarcely rises above the level of the Gulf, and that the nearest land, Cape Florida, is almost as depressed. We must also call to mind the prevalence of easterly winds at that place, which, although humid, find no elevated object, and but few cold currents, over the south-eastern surface of the Gulf, to condense their vapor into rain. They are, in fact, there augmented in temperature, and become still more highly charged with vapor, than before their arrival on the Gulf. In this condition, they arise, as from a great evaporating basin, and wheel toward the pole. When they reach the northern coasts of the Gulf, about the thirtieth parallel, they begin to traverse a cooler region; the inequalities of temperature between land and water, begin to exert an influence upon them: and they are, frequently, met by northerly winds. Under these agencies, their vapor is condensed into copious rains. At Mobile, the amount which falls, is more than double that of Key West; and the mean of all the stations around the northern arc of the Gulf, 56.190 inches, is to that of Key West, as that number is to 30.783. This, in fact, is *the* rainy zone of the Interior Valley; not only rising eighty-two per cent. upon Key West, but twenty-four per cent. over the average of the fourth group, the next highest to the one we are now considering. Much of the rain in this maritime zone, falls in showers; which are unequal in number and copiousness, at places so near each other, that we should expect uniformity. Thus the difference of Mobile and New Orleans, by simultaneous observations, in 1841–'42, was no less than nineteen inches. Whatever allowance we can reasonably make for errors of observation, we must still admit a great disparity. This inequality may, indeed, be announced as prevailing over the entire Valley; of which the proofs will be cited as we advance.

When we leave the Gulf coasts, and advance into the interior, keeping to the east of the Mississippi, the first and second stations, Huntsville and Nashville, show their southern position by averages, respectively, almost as high as the mean of the stations near the Gulf; but as we continue to the north, through the group No. IV, to which the two just mentioned belong, we find the quantity lessening; yet the mean of the whole is only 10.7 inches below that of the Gulf stations. When we ascend from the latter, on the western side of the Mississippi, through the third group, we find the most southern, Fort Towson, which, of the whole, lies nearest to the Gulf, to have the highest number, 46.73 inches. All the more northern stations, up to Fort Snelling, have much lower numbers: St. Louis, the highest, does not reach 40 inches, and Fort Gibson, the most western and southern of the group, is only 30.64. Fort Smith, in the same region, is 35.25. These distant western posts are nearly in the same latitude with Huntsville and Nashville, on the eastern side of the Mississippi, which are respectively represented by 54.89 and 55.00, or about twenty-two inches more. St. Louis on the eastern margin of the group, is about equal to Portsmouth, but more than seven inches below Cincinnati. Fort Leavenworth, in the same latitude with Marietta, is nearly eight inches behind it, and Fort Crawford, but little north of Steubenville, is six inches lower. The mean of the eastern group is 45.317, of the western, 35.017 — difference, 10.3. Now this annual difference of ten inches of rain and snow between the regions on the opposite sides of the Mississippi, is a deduction from too many observations, to permit the conclusion, that it can be the result of accidental or temporary causes; and, therefore, it presents an interesting subject of inquiry, to which we may proceed.

It cannot be doubted that nearly all the rain which falls in the interior of our Valley, is brought from the Gulf of Mexico by our southerly winds. When they reach the middle latitudes, a cooler atmosphere condenses a portion of their vapor into rain, or snow; and they often meet with north-east currents, which greatly increase the condensation. Having such a source, the rains will be most copious, over those places which lie most directly in the track of the Gulf winds; which are the stations between the Mississippi and the Appalachian Mountains, in the States of Alabama, Mississippi, Tennessee, Kentucky, Indiana, and Ohio. When we cross the Mississippi, and advance into the west, every mile carries us further from that humid, south-west wind, which has traversed, or started from the surface of the Gulf of Mexico; and, of course, the quantity of rain suffers diminution. We enter a region which becomes dryer and dryer, the further it is penetrated; and beyond the hundred and second meridian, as Doctor Gregg has informed me, scarcely ever refreshed by evening or morning dews. The rivers of that side of the Interior Valley, testify to the deficiency of rain, for, in proportion to the extent of surface which they drain, they are fewer, and less abundant in water, than those on the eastern side of the Mississippi; although most of them have the advantage of originating in the Rocky Mountains. Moreover, the superficial parts of that region are more sandy and bibulous, than those on the eastern side of the Mississippi, and, therefore, a greater proportion of the water which falls, sinks into the earth. Thus both geographical position and geological constitution, contribute to an aridity which must continue, until the state of the surface is changed, or the Gulf of Mexico is removed further west, or the Rocky Mountains sunk so low, as to admit the winds of the Pacific Ocean. This dryness has sometimes been ascribed to the absence of forests: but *why are* they absent? They are said to have been burnt up by the Indians. The annual burnings, however, do not destroy the woods in the humid, river valleys of those immense plains; and the Indians were once more numerous on the eastern side of the Mississippi than the western, and yet the forests remained. The truth is, that if the desert had ever been overspread with a vigorous forest, it would have maintained and perpetuated itself. The influence of trees in producing rain, is, perhaps not very great; but their power of preserving the moisture of the soil in which they grow, is unquestionable; for they intercept the rays of the sun, retard the velocity of the winds, and thus diminish the rate of evaporation and drying. They *may* augment the depth of rain — they *certainly* secure to the soil a greater proportion of what falls, especially in summer when it is most needed.

We come now to the fifth and last group of stations, those which lie round the Northern Lakes. The mean of thirteen stations is 33.360, which is the lowest of the whole. The highest, Fort Howard, only reaches 38.830 — the lowest, Pottsdam, falls to 28 inches. We should not, I think, have expected to find the quantity of rain so small in this lacustrine region; yet there seems no just reason for doubting the accuracy of the observations, most of which were continued through a long period of years. One cause of the diminished amount, in this region, compared with the region lying between it and the Gulf of Mexico, is, doubtless, its greater distance from the Gulf — another, its higher latitude; which brings an increasing prevalence of dry, north-west wind. The same quantity of rain in this region can maintain the moisture of the earth much longer than in that west of the Mississippi; for, *first*, less of it sinks deep below the surface; *second*, the power of the sun is diminished by the higher latitudes; *third*, evaporation from the lakes keeps the atmosphere so replenished with moisture, that evaporation from the surface of the adjacent land is retarded. The effect of lacustrine evaporation is rendered manifest, by the girdle of lofty forest trees, which surrounds every lake, and beyond which, at the distance of a few miles, we frequently enter extensive prairies. These forests bear to the lakes, the same relation which the trees along the rivers west of the Mississippi, bear to them.

III. Distribution through the Year. — The distribution of rain and snow, through the months and seasons, at eighteen stations, is presented in the foregoing table; but a further induction is necessary to their comparison with each other; I have, therefore constructed a subordinate table, which shows the months of maxima and minima, and, likewise, that which, at each station, approaches nearest to the mean month of the year. The table also presents, for each station, a quarterly mean, and likewise, a quarterly mean for each group of stations, an average quarter, or equal fourth part, of the whole, being prefixed as a term of comparison. By this method, and the use of the signs plus and minus, the eye at once discovers which are the rainy, and which the dry seasons, at every place, and for every group of places.

TABLE II.—MONTH OF GREATEST AND LEAST RAIN, AND THAT WHICH COMES NEAREST THE MEAN OF THE WHOLE; ALSO, THE AMOUNT IN THE DIFFERENT SEASONS COMPARED WITH THEIR MEAN; CONDENSED FROM THE PRECEDING TABLE.

The figures + and — signify above or below the mean.

Groups of Stations, from the Preceding Table.	MEAN & EXT. MOS.			QUARTERLY MEAN OF EACH STATION.					MEAN OF EACH GROUP.				
	Mean, or 12th	Highest mo.	Lowest mo.	Mean Season, or ¼ yr.	Winter.	Spring.	Summer.	Autumn.	Mean Quarter.	Winter.	Spring.	Summer.	Autumn.
GROUP I. INSULAR.													
Key West, ...	Jul.	My.	Feb.	7.696	—3.751	+7.835	+8.997	+10.200	7.696	—3.751	+7.835	+8.997	+10.200
GROUP II. N. G. COAST.													
New Orleans, . . .	Nov.	Dec.	My.	12.801	+15.217	—10.574	+13.351	—12.062	Mean of 4 stations				
Mobile, ...	Mar.	Jan.	Oct.	16.104	+18.273	—14.242	+17.999	—13.900	14.438	+15.940	—14.154	+14.947	—12.710
St. Francisville, .	Nov.	Ap.	Au.	13.817	—13.670	+16.550	—13.080	—11.970					
Natchez, ...	Nov.	Jul.	Oct.	15.030	+16.600	+15.250	+15.360	—12.910					
GROUP III. W. OF MISS.													
St. Louis, ...	Mar.	Je.	Feb.	10.385	—6.520	+11.870	+14.350	—8.800	10.385	—6.520	+11.870	+14.350	—8.800
GROUP IV. E. OF MISS.													
Huntsville, ...	Jul.	Mar.	Oct.	14.105	+15.429	+15.626	—13.677	—11.689	Mean of 6 stations				
Nashville, ...	Jul.	Ap.	Dec.	13.750	—11.990	+15.048	+14.468	—13.496					
Portsmouth, ...	Ap.	Je.	Dec.	9.600	—8.500	+10.000	+11.600	—8.400	11.406	—10.306	+12.003	+13.041	—10.274
Cincinnati, ...	Nov.	Je.	Feb.	11.800	—9.920	+11.890	+14.610	—10.780					
Marietta, ...	Au.	Je.	Jan.	10.320	—9.120	—10.060	+12.990	—9.120					
Steubenville, . . .	Sep.	Au.	Feb.	8.833	—6.879	+9.394	+10.902	—8.157					
GROUP V. N. LAKES.													
Hudson, ...	Mar	Mar.	Dec.	9.170	—6.329	+10.952	+11.352	—8.049	Mean of 6 stations				
Rochester, ...	Jul.	Sep.	Feb.	8.730	—5.690	—7.020	+8.780	+13.430					
Toronto, ...	Oct.	Sep.	Feb.	8.200	—5.091	—7.014	+10.042	+10.651	8.304	—6.013	—7.628	+9.357	+10.206
Mexico: Rens. Os.	Jul.	Oct.	Ap.	8.040	—7.700	—6.940	+7.830	+9.690					
Fredonia, ...	Jul.	Sep.	Feb.	8.630	—6.690	—4.800	+8.800	+11.130					
Lowville, ...	Au.	Jul.	Ap.	7.060	—4.580	—6.040	+9.340	+8.290					

We see from this table that there is no particular month which, at a majority of the stations, comes nearest to a mean month for the year. July is that month for six, or one-third of the stations. They are not confined to one region, but extend from Key West to Fredonia, on the shores of Lake Erie. November is the month, at four places, three of which are in the south, the fourth in latitude 39°. March occurs once in the first and twice in the second group. April, September, and October, each occur once. January, February, May, June, and December, are not the mean months of any station. The only generalization which the table permits, is, that the mean months fall chiefly in summer and autumn, eight occurring in the former and six in the latter season, from July to November inclusive; while the remainder and larger part of the year has but four.

The months of greatest rain, are still more dispersed through the calendar—ten out of twelve being found in the column of *maxima*. June occurs four times, and all the stations are in the middle latitudes. The column of *minima* shows that, at seven stations, February has less rain that any other month. They are dispersed from south to north. October and December are, respectively, the dry months at three stations. Thus February and June stand in some degree of antagonism.

At four out of the five groups of stations, winter brings less rain than the average quarter of the year. The exception is found in the group which embraces New Orleans. Spring is above the mean quarter in three of the groups—below at two; but here, again, the difference is not connected with latitude. Summer is above at every station, showing that throughout the Valley it is the rainy season. Autumn is above in two and below in three; showing that next to winter it is the dryest. If we enumerate the seasons in the order of their comparative raininess, beginning with the least, they stand—winter, autumn, spring, summer. It should not surprise us to learn, that so much rain falls in summer, notwithstanding the air then seems so dry and the streams fall so low. The warmth of the surface of the earth, at that season, causes a rapidity of evaporation unknown in the other quarters of the year; and the high temperature of the air admits of its receiving a great quantity of vapor, without becoming moist to our feelings. Much of this is thrown down in autumn, when the rate of terrestrial evaporation is every day diminishing; so that winter becomes the least rainy season of the whole, except in the group around the Gulf of Mexico, where that season, as might be expected, takes the place of autumn.

SECTION II.

CLEAR, CLOUDY, RAINY, AND SNOWY DAYS.

I. We cannot infer the relative number of clear, cloudy, and rainy days, from knowing the relative quantities of rain and snow which fall at different places; for a large fall of rain, in the course of the year, is not incompatible with a great number of fair days. On the other hand, there may be a great deal of cloudy weather, with much drizzling, and yet the annual quantity of rain may be comparatively small. It is necessary then to ascertain from observation the state of the weather as to cloudiness, and the frequency of rain and snow. Nothing is more difficult, however, than to assign the proportions of clear and cloudy weather, seeing that many days in every month of the year wear such an aspect that while one observer might record them as being clear, another would write them down cloudy. Then, again, the canopy of clouds may, on some days, be much thicker and more impervious to the rays of the sun than others, and yet both will be recorded in the same language. Sometimes, moreover the clouds will float very low, at other times very high in the atmosphere, when their influence on the radiation of heat from the earth will be very different, as will also the amount of caloric which they return, by radiation, upon the earth; yet this will not appear from the record. Still further, clouds have different forms and aspects, the results of the mode in which the vapor of which they are composed, is set free and aggregated; but these forms, of which the elementary types are few and simple, have, in most instances, not been recorded; finally, observations have seldom been made in the night. In reference to that portion of the twenty-four hours, we know, with accuracy, but little on this point; yet, I am persuaded, that in the middle latitudes, at least, the nights are less cloudy and rainy than the days.

In the following table I have attempted to give such an abstract of the observations, made in different parts of the Valley, as will show the proportions of clear and cloudy weather, and the number of rains and snows; but, I fear, that the larger portion of the observations are not entitled to full confidence. In most of the tables there are two columns, which are headed clear and cloudy; in several a third, entitled variable or mixed. In these cases I have divided the numbers equally, distributing them under the two former heads, thereby augmenting both, and making them, when united, equal to the whole number of days in the year. Many of the observers have not included the days of rain and snow in the column of cloudy days, which, of course, has been done in constructing the table. The stations have been arranged into the same groups, as those of the table, giving the quantity of rain.

Table showing the Mean Number of Clear, Cloudy, Rainy, and Snowy Days, for the Year, at twenty-three Stations, arranged in Groups.

Groups.	Stations.	Weather.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total in days.
I. and II. In and around the Gulf of Mexico	Key West, 5 Years, *Whitehead.*	Rainy.	6.0	4.2	4.2	3.8	8.8	7.6	11.0	10.0	12.5	9.4	7.2	7.6	92.3
	Fort Brooke,	Clear,	21.3	22.6	24.7	21.7	23.0	17.7	11.3	14.6	17.0	23.7	25.0	22.0	244.0
	5 Year,	Cloudy,	9.7	6.3	6.3	8.4	8.0	12.3	29.7	10.4	13.0	7.3	5.0	9.0	131.4
	Met. Reg. U.S.A.	Rainy.	2.7	5.0	4.3	4.7	5.7	8.0	12.0	10.7	5.3	3.3	2.0	4.0	67.7
	Cant. Clinch, Pen-	Clear,	18.4	16.0	17.4	19.2	20.2	14.6	13.2	13.6	19.8	23.0	20.6	14.5	210.6
	sacola Bay,	Cloudy,	12.6	12.4	13.6	10.8	11.8	15.4	17.8	15.0	10.2	8.0	9.4	16.4	153.4
	7 Years,	Rainy,	7.2	8.8	9.2	5.6	6.4	8.4	12.8	12.0	6.8	4.6	7.2	11.6	100.6
	Met. Reg. U.S.A.	Snowy.		0.2											.2
	Mobile,	Clear,	10.6	13.6	12.0	16.0	19.0	13.5	6.0	13.0	10.0	21.0	20.0	15.5	168.0
	2 Years,	Cloudy,	21.0	14.5	19.0	15.0	12.0	16.5	25.0	18.0	20.0	10.0	10.0	15.5	196.5
	North.	Rainy.	16.6	10.0	10.0	10.5	8.0	12.5	18.5	15.0	13.5	7.0	7.0	7.0	135.5
	New Orleans,	Perf. Clear,	4.8	7.7	5.7	5.3	6.0	3.3	0.0	4.0	3.3	10.7	8.7	10.7	70.2
	3 Years,	Cloudy,	26.2	20.6	25.3	24.6	25.0	26.7	19.0	23.7	26.6	20.3	13.0	13.0	264.0
	Lillie.	Rainy.	10.7	7.3	7.3	7.3	7.3	7.7	12.0	9.0	13.3	4.3	8.3	7.3	101.8
	Fort Jesup,	Clear,	14.7	16.3	16.7	16.2	18.7	20.5	18.3	19.0	19.3	23.5	19.5	16.6	219.3
	8 Years,	Cloudy,	16.3	12.0	14.3	13.8	12.3	9.5	12.7	12.0	10.7	7.5	10.5	14.4	146.0
	Met. Reg. U.S.A.	Rainy,	7.1	5.7	9.2	7.1	6.1	6.7	6.9	5.3	3.9	2.7	4.5	6.9	72.1
		Snowy.	0.2	0.3											.5
	Natchez,	Clear,	4.0	5.0	4.0	3.0	4.0	0.7	0.7	1.0	3.0	7.0	5.0	6.0	43.4
	6 Years,	Cloudy,	21.0	13.0	27.0	27.0	26.0	29.0	30.0	30.0	27.0	24.0	25.0	25.9	310.0
	Tooley.	Rainy,	8.0	8.0	10.0	7.0	6.0	9.0	11.0	7.0	8.0	4.0	8.0	8.0	94.0
		Snowy.			0.3										0.3

	VICKSBURG, 3 Years, *Hatch.*	Clear,													22.3
		Cloudy,													14.2
		Rainy.													8.9
III. Along the west of the Mississippi.	FORT GIBSON, 3 Years, *Met. Reg. U.S.A.*	Clear,	18.3	16.7	15.7	17.3	16.7	23.0	20.7	25.3	20.0	20.0	18.7	18.3	230.7
		Cloudy,	12.7	11.7	15.3	12.7	14.3	7.0	10.2	5.7	10.0	11.0	11.3	12.7	134.7
		Rainy,	1.4	2.6	4.0	4.7	7.6	3.7	3.3	0.7	2.3	4.0	1.7	3.7	39.1
		Snowy.	1.0	0.7	0.3								0.3	1.3	3.6
	ST. LOUIS, 16 Years, *Engelmann.*	Clear,	10.4	9.5	12.5	11.6	11.2	9.4	13.6	13.2	14.4	14.6	10.5	11.1	141.0
		Rain or Snow.	7.8	7.9	8.0	8.9	9.6	10.0	7.4	7.3	6.2	7.6	8.1	6.4	95.7
	COUNCIL BLUFFS, 5 Years, *Met. Reg. U.S.A.*	Clear,	23.0	18.5	15.3	17.0	18.0	19.8	22.5	24.2	19.7	20.8	17.7	19.8	236.3
		Cloudy,	8.3	9.9	15.7	13.0	13.0	10.2	8.5	6.8	10.3	10.2	12.3	11.2	129.4
		Rainy,	0.5	0.9	3.2	3.5	7.0	5.2	4.0	1.3	2.8	4.5	1.5	1.2	35.6
		Snowy.	2.9	3.2	2.5	1.3						0.2	2.8	2.2	15.1
	BLOOMINGTON, 5 Years, *Parvin.*	Clear,	15.2	17.6	19.2	19.4	20.0	20.0	24.8	23.2	20.8	20.0	14.9	19.2	234.3
		Cloudy,	15.8	10.6	11.8	10.6	11.0	10.0	6.2	7.8	9.2	10.2	15.1	9.8	128.1
		Rainy,	2.6	2.2	6.8	8.8	10.4	11.0	8.0	8.0	6.0	6.8	4.2	1.8	76.6
		Snowy.	5.0	2.6	2.2							0.4	2.4	4.2	16.8
	FORT SNELLING, 8 Years, *Met. Reg. U.S.A.*	Clear,	20.5	17.8	17.8	16.3	17.8	16.8	20.7	21.8	19.2	19.0	11.8	18.8	218.3
		Cloudy,	10.5	10.5	13.2	13.7	13.2	13.2	10.3	9.2	10.8	12.0	18.2	12.2	147.0
		Rainy,	0.7	0.5	3.7	5.7	9.3	9.5	6.3	5.0	5.3	3.2	3.8	0.7	53.7
		Snowy.	3.6	6.0	3.7	2.2	0.4					0.5	4.8	5.3	26.5
IV. East of the Mississippi, and south of the Lakes.	HUNTSVILLE, 13 Years—*Allan.*	Clear,	16.0	15.7	15.3	18.7	12.3	12.7	18.0	16.3	17.0	24.0	16.7	13.7	196.4
		Cloudy,	15.0	15.0	15.7	11.3	15.3	17.3	13.0	14.7	13.0	6.7	13.3	17.3	167.6
	CINCINNATI, *Drake* 6 Years, *Ray* 14 "	Clear,	13.7	13.5	17.5	16.9	18.7	20.3	22.0	22.8	22.5	20.0	12.0	12.5	212.4
		Cloudy,	17.0	15.3	13.3	14.6	12.2	9.8	8.5	7.9	8.4	10.1	16.3	17.0	150.4
		Clear,	15.0	14.7	16.6	17.6	18.3	18.4	21.5	19.0	20.1	18.8	13.8	13.3	207.1
		Cloudy,	16.0	13.7	14.4	12.4	12.7	11.6	9.5	12.0	9.9	12.2	16.2	17.7	158.3
	MARIETTA, 5 Yrs.—*Hildreth.*	Clear,	15.0	16.0	20.0	19.0	21.0	23.0	22.0	22.0	18.0	22.0	15.0	15.0	228.0
		Cloudy.	16.0	12.0	11.0	11.0	8.0	7.0	9.0	9.0	12.0	9.0	15.0	16.0	135.0

TABLE OF CLEAR, CLOUDY, RAINY, AND SNOWY DAYS—CONTINUED.

Groups.	Stations.	Weather.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total in days.
V. Around the Northern Lakes.	STEUBENVILLE, 10 Years, *Marsh.*	Clear,	10.0	9.2	13.4	13.2	12.0	12.2	17.0	17.0	16.3	14.5	10.0	7.7	153.5
		Cloudy,	21.0	19.0	17.6	16.8	19.0	17.8	14.0	14.0	13.7	16.5	20.0	23.3	212.7
		Rainy,	5.8	5.3	7.8	9.0	11.7	11.7	9.6	9.5	7.4	7.3	7.3	6.4	98.8
		Snowy.	5.7	6.4	4.8	2.3	0.3					0.8	4.9	6.9	32.1
	FREDONIA, 8 Years, *New York Repts.*	Clear,	8.5	10.9	14.5	16.5	18.3	17.1	19.8	20.4	15.0	13.2	5.4	6.3	165.9
		Cloudy,	22.5	17.6	16.5	13.5	12.7	12.9	11.2	10.6	16.9	17.7	24.6	24.7	199.5
		Rainy,	4.1	1.7	4.2	4.4	8.7	8.1	6.2	6.0	7.5	8.7	4.8	4.3	68.7
		Snowy.	7.1	6.1	4.6	1.3	0.2	0.2			0.1	1.6	5.2	6.1	32.5
	ROCHESTER, 14 Ys. *Wetherell.*	Clear,													169.0
		Cloudy.													202.0
	MEXICO, 7 Years, *New York Repts.*	Clear,	11.2	11.6	14.8	18.7	18.6	19.3	21.7	21.2	17.9	15.3	8.5	9.7	188.5
		Cloudy,	19.9	16.7	16.2	11.3	12.4	10.6	9.3	9.8	12.1	15.7	21.5	21.3	176.8
		Rainy,	3.2	0.9	3.9	4.8	8.5	8.8	7.6	5.5	8.7	8.1	4.5	3.6	68.1
		Snowy.	7.6	8.5	5.9	1.7	0.2					1.4	5.6	5.5	36.4
	LOWVILLE, 8 Years, *New York Repts.*	Clear,	9.1	9.4	12.8	15.2	13.3	14.4	17.1	17.6	14.6	11.8	8.7	6.8	150.8
		Cloudy,	21.9	18.8	18.2	16.1	17.4	15.6	13.9	13.4	15.4	19.1	21.3	24.3	215.4
		Rainy,	1.6	0.6	2.9	3.8	8.1	7.6	7.1	5.4	5.6	6.5	3.9	1.7	54.8
		Snowy.	7.9	5.3	4.9	1.9	1.1				0.2	2.0	4.6	7.1	35.0
	FORT HOWARD, 9 Years, *Met. Reg. U.S.A.*	Clear,	15.3	12.8	15.7	14.6	19.4	17.1	20.6	18.2	15.4	15.9	10.7	13.0	188.7
		Cloudy,	15.7	15.4	15.3	14.8	11.6	12.9	10.4	13.0	14.6	15.2	19.2	18.0	178.1
		Rainy,	0.7	0.8	1.9	4.0	3.4	5.3	4.6	7.8	6.3	3.2	2.6	0.4	41.0
		Snowy.	4.7	3.6	4.1	2.0						0.7	2.8	4.0	21.9
	FORT BRADY, 6 Years, *Met. Reg. U.S.A.*	Clear,	9.4	10.0	15.8	14.0	13.8	14.4	16.0	17.6	11.6	10.6	6.6	6.0	145.8
		Cloudy,	20.8	18.3	15.4	16.2	17.2	15.6	15.0	13.5	18.5	18.4	23.4	25.0	217.5
		Rainy,	1.2	1.2	1.9	7.4	11.8	8.0	8.9	7.6	12.8	7.4	6.6	3.4	78.2
		Snowy.	14.0	9.9	8.9	3.9	1.0				0.9	3.0	6.6	11.8	60.0

II. I have not attempted to form a tabular view of results from the foregoing table. Its deficiencies and anomalies are too many to warrant such a generalization; yet there are a few conclusions which may be drawn from it, and held subject to future correction.

1. In regard to the number of clear and fair days in the mean year, in the different groups of stations, we find for five stations, around the Gulf of Mexico — Group II — the number is two hundred and thirteen. This excludes Natchez and New Orleans, which, included, would reduce the average to one hundred and sixty-eight. But, at the former, the number reported is only forty-three—at the latter, seventy. These numbers must refer to days absolutely cloudless; indeed, Mr. Lillie, the New Orleans observer, tells us so, in regard to that place. Such observations cannot be compared with those which are generally recorded. Group II—region west of the Mississippi—gives, as the average of five stations, two hundred and twelve clear days. Group IV—east of the Mississippi—presents, as the mean of five stations, one hundred and ninety-eight. Group V—region of the Lakes—affords an average, for six stations, of one hundred and sixty-seven. Thus we find that the number of fair days increases as we go to the southwest from the Northern Lakes.

2. The number of rainy days at Key West, Group I, is ninety-two; the average number of Group II, around the Gulf, is ninety-four; of Group III, west of the Mississippi, seventy; of Group IV, east of that river, unknown; of Group V, around the Lakes, one hundred and one. Thus the region of the Lakes has more cloudy weather, and a greater number of rains or snows, than any other. But it is when we compare that region, with the great prairies, west of the Mississippi, that we find the highest differences. The former has not less than forty-five clear days more than the latter, and thirty-one fewer days of rain or snow; while the depth of water, falling from the atmosphere, in the two regions is nearly the same. Of all the Lake stations, Fort Brady, east of Lake Superior, has the greatest number of cloudy, rainy, and snowy days. It will be instructive to compare them with Fort Snelling, on the Mississippi, which lies nearly in the same latitude:

	Clear.	Cloudy.	Rainy.	Snowy.	Rainy and Snowy.
Brady,	145.8	217.5	78.2	60.0	138.2
Snelling,	218.3	147.0	53.7	26.5	80.2

In this comparison, we find the proportions of clear and cloudy days reversed; while the number of rainy days at Brady is fifty per cent. greater than at Snelling, and those of snow, upward of a hundred per cent. more. We may extend the comparison, by placing a station on the south coast of Lake Erie, by the side of one on the Missouri River, varying from it, in latitude, but one degree.

	Clear.	Cloudy.	Rainy.	Snowy.	Rainy and Snowy
Fredonia,	166.0	199.0	68.7	32.5	101.2
Council Bluffs,	236.0	129.0	35.6	15.1	50.7

If we make a large allowance for inaccuracies of observation, there is still left enough of disparity between these numbers, to show that the great plains have a far brighter sky and dryer atmosphere than the Lakes.

In each group, the months having the greatest and least number of clear, cloudy, and rainy days, are respectively the following:

	GREATEST.			LEAST.		
	Clear.	Cloudy.	Rainy.	Clear.	Cloudy.	Rainy.
Group I,	——	——	Sept.	——	——	April.
" II,	Oct.	July.	July.	July.	Nov.	Oct.
" III,	Aug.	Nov.	May.	Nov.	Aug.	Aug. & Sep.
" IV,	Oct.	Dec.	——	Dec.	Oct.	——
" V,	July.	Dec.	Sept.	Nov.	July.	Feb.

III. The first snow mentioned in the table, is at Cantonment Clinch, Pensacola Bay, in latitude 30° 31′. At Fort Jesup, a degree further north, it is noted as occurring in January and February. We may, perhaps, take the thirty-second degree, as that at which it occurs in every winter month. As we advance north, the number of snowy days regularly increases. At Fort Snelling, snow falls in all the month of the year, except June, July, August, and September. At Fort Brady, in every month, but the three summer. At the Arctic Circle,* where the number of cloudy days in the year amounts to two hundred and twenty-three, it snows in every month, and rains only in June, July, and August. Thus the sixty-sixth parallel reverses the order of the thirty-second. The loss of sixty degrees of mean temperature, works out this change, in the relations of rain and snow. Below the fortieth parallel, it never lies on the ground throughout the winter months — above that latitude, as far as Lake Superior, it is often dissolved by warm rains, and leaves the earth uncovered in the midst of winter.

The aggregate depth of snow in the different latitudes of the Valley, has not been determined. Mr. McCord, from observations continued for ten years, states it, for Montreal, at 69.7 inches, or nearly six feet. In that period, it varied from 47.7 in. to 107.6 in., or more than a hundred per cent. A similar range is observed everywhere south of that city.

* Parry's Second Voyage.

SECTION III.

HUMIDITY.

I. The Dew Point.—As the dryness or moisture of a climate, cannot be inferred from the quantity of rain which falls, nor even from the relative number of clear and cloudy days, recourse must be had to hygrometric observations. Of these, few have, as yet, been made, within the geographical limits assigned to this work. In former times, I made observations at Cincinnati, with the expansible hygrometers of that day, but such records are now of little value.

It is known to all the world, that air, which does not feel damp nor impart moisture to the bodies immersed in it, may be made to do both, by lowering its temperature. Now, when two volumes of air, having the same sensible heat, are subjected to cooling, the one which first begins to deposit moisture on the refrigerator, contains the greater quantity of water, and is said to have the higher dew point. The range through which the thermometer falls, before the dew appears, is called the complement of the dew point. The less vapor there is in air of the same temperature, the greater will be the number of degrees in the complement, *et vice versa*. When air feels damp, and wets the bodies with which it is in contact, it is saturated with vapor; and then the complement of the dew point is annihilated. If a reduction to a small extent, say five degrees, cause the condensation of vapor, the complement is five degrees; if the reduction must be thirty degrees, before that phenomenon will show itself, that number expresses the complement. If air, at the temperature of thirty-two degrees, be saturated with vapor, it is moist to our senses; but if its temperature be raised, it will feel dry; and if, with the increase of temperature, up to seventy-two degrees, for example, there should be no addition of water, it comes to feel as if it contained none, although the absolute quantity continues the same.

It is incorrect to speak of the capacity of air for holding water in solution, for evaporation goes on more rapidly as the air is less dense. Wind, or air in motion, promotes evaporation, by carrying away the vapor which hovers over the surface from which it has arisen. Caloric, in short, is the cause of vapor, and the quantity which can exist in any portion of the atmosphere, in such a state as not to impart moisture, or be in any manner perceptible to our senses, is determined by the temperature; but as the air into which the vapor rises, and the vapor itself, will necessarily have the same temperature, it is common to speak of the capacity of air for holding vapor in solution. This capacity increases at a higher ratio, than the increase of temperature. Thus, starting from any point of Fahrenheit's scale, it is found, that for every twenty degrees of elevation, the quantity of vapor necessary to saturate the air, is doubled.

If water be passed up the tube of a barometer, into the vacuum over the column of mercury, it expands into vapor, and sinks the column. If heat be applied, the rarefaction of the vapor causes a further descent of the mercury. By experiments of this kind, the expansive force or pressure, generally called tension of vapor, for every degree of temperature, has been determined.

The following table shows the quantity of vapor necessary to the saturation of a cubic foot of air, at every degree of temperature from —13° to +95°, of Fahrenheit's scale; and also the tension for the same degrees. It is constructed from two tables in Kaemtz's Course of Meteorology. I have reduced the volume of air from a cubic metre to a cubic foot, and brought the weight of vapor from grammes to grains troy, and the degrees of temperature from the centigrade scale to that of Fahrenheit. A similar *translation* has been made of what relates to the tension of vapor, the scale of the thermometer being changed, and the barometric hights being given in decimals of inches, instead of millimetres. The calculations of the first part of the table are by Kaemtz, from his own experiments; those of the second part, are by August, from the experiments of Dalton.

TABLE

OF THE WEIGHT OF VAPOR, IN GRAINS TROY, REQUIRED TO SATURATE AN ENGLISH CUBIC FOOT OF AIR, WITH THE CORRESPONDING TENSION OF VAPOR, IN ENGLISH INCHES; AT EVERY DEGREE OF FAHRENHEIT'S THERMOMETER, FROM —13° TO +95°.

Degrees of Fahrenheit.	Gs. troy in cubic foot.	Tension in Eng. inches.	Degrees of Fahrenheit.	Gs. troy in cubic foot.	Tension in Eng. inches.	Degrees of Fahrenheit.	Gs. troy in cubic foot.	Tension in Eng. inches.	Degrees of Fahrenheit.	Gs. troy in cubic foot.	Tension in Eng. inches.
°			°			°			°		
—13	0.0406	0.0303	+15	0.1303	0.1015	+43	0.3629	0.3001	+71	0.8958	0.7893
12	.0425	.0316	16	.1354	.1053	44	.3759	.3113	72	.9231	.8166
11	.0445	.0329	17	.1407	.1097	45	.3887	.3229	73	.9518	.8437
10	.0466	.0344	18	.1462	.1143	46	.4012	.3347	74	.9818	.8710
9	.0488	.0361	19	.1518	.1194	47	.4144	.3471	75	1.0126	.8986
8	.0510	.0381	20	.1580	.1244	48	.4280	.3600	76	1.0431	.9245
7	.0529	.0398	21	.1645	.1294	49	.4437	.3743	77	1 0735	.9500
6	.0545	.0414	22	.1713	.1346	50	.4599	.3889	78	1.1062	.9856
5	.0572	.0432	23	.1780	.1398	51	.4757	.4018	79	1.1392	1.0210
4	.0601	.0452	24	.1851	.1457	52	.4916	.4151	80	1.1727	1.0555
3	.0623	.0476	25	.1923	.1517	53	.5074	.4299	81	1.2071	1.0899
2	.0647	.0498	26	.2003	.1577	54	.5240	.4448	82	1.2429	1.1242
1	.0679	.0513	27	.2081	.1639	55	.5419	.4599	83	1.2796	1.1597
Zero.°	.0699	.0532	28	.2157	.1702	56	.5602	.4764	84	1.3169	1.1962
+ 1	.0701	.0556	29	.2232	.1768	57	.5787	.4938	85	1.3546	1.2342
2	.0735	.0581	30	.2307	.1836	58	.5987	.5109	86	1.3924	1.2726
3	.0790	.0607	31	.2388	.1909	59	.6191	.5279	87	1.4341	1.3130
4	.0833	.0635	32	.2471	.1984	60	.6374	.5463	88	1.4762	1.3538
5	.0872	.0663	33	.2553	.2062	61	.6562	.5619	89	1.5199	1.3962
6	.0905	.0687	34	.2639	.2142	62	.6774	.5850	90	1.5622	1.4393
7	.0941	.0714	35	.2742	.2227	63	.6990	.6047	91	1.6047	1.4837
8	.0995	.0748	36	.2844	.2313	64	.7214	.6240	92	1.6496	1.5298
9	.1036	.0783	37	.2946	.2400	65	.7448	.6438	93	1.6962	1.5772
10	.1071	.0818	38	.3057	.2492	66	.7688	.6642	94	1.7428	1.6253
11	.1107	.0856	39	.3174	.2586	67	.7934	.6890	95	1.7894	1.6735
12	.1144	.0895	40	.3284	.2683	68	.8182	.7150			
13	.1196	.0934	41	.3393	.2781	69	.8436	.7397			
14	.1253	.0974	42	.3510	.2891	70	.8693	.7646			

Different methods have been invented, for ascertaining the dew point. If a lump of ice be thrown into a bright, metallic pitcher, containing water, dew or moisture, will in a short time, begin to be deposited from the air, on the outside of the vessel. The temperature of the immersed thermometer at that moment, is called the dew point; and the difference between it, and the temperature of the air, is the complement of the dew point. By a reference to those figures, in the table, which correspond with the two found in the experiment, the weight of the vapor then in the atmosphere, with its tension, both corresponding to the dew point, may be seen; and, also, how much more would be required to saturate the air, at the temperature which it then has.

Another method of determining the same thing, is to observe the temperture of the air, and then wrap the bulb of the thermometer with some fragments of thin muslin, or locks of cotton, and after wetting it with water, to hold it in the wind, or swing it in the air, till the mercury ceases to fall. The cessation, indicates that no further evaporation is going on, for the temperature of the water around the bulb, has been reduced to the point at which the air can receive no more vapor from any source. Having ascertained the lowest degree to which the wet bulb can be reduced, the difference between it, and the temperature of the air, must be multiplied by one hundred and three, and the product divided by the temperature of the wet bulb; lastly, the quotient must be subtracted from the temperature of the air, and the remainder is the dew point. If the air be below the freezing point, the bulb of the thermometer must be dipped in water before being swung, when a thin pellicle of ice will form over it, from which the evaporation will take place.*

I hope those physicians who are familiar with these elementary matters, will pardon their introduction, which has been done under the impression that many of our brethren have not studied this subject, and have not even the necessary books.

II. Moisture. — From what has been said, we perceive that the absolute quantity of vapor in the atmosphere, if it were always saturated, would be in proportion to its temperature, and would, therefore, decrease from the tropical to the polar circle—from July to January—and from the maximum heat of the afternoon to the minimum heat of the following morning. If, however, it be not saturated, it may, at a high temperature, contain no more vapor than that which has a much lower temperature, but is saturated. As a general fact, the absolute quantity, is far greater in the warm than the cold latitudes; and yet the atmosphere of the latter, may be the damper of the two, because it may approach nearer to saturation.

The nature of the surface over which the air rests, not less than its temperature, exercises an influence on the absolute quantity of vapor.

In our climatic geography, there are five great regions, which may be presumed to differ widely from each other in their absolute quantities of atmospheric vapor; and also in the dew point complement. They are, *first*, the Gulf of Mexico; *second*, the region west of the Mississippi River; *third*,

* Espy on Storms.

the region east of that river, between the Gulf and Lakes; *fourth*, the Lakes themselves; *fifth*, the Arctic regions. Let us consider them in succession.

1. *The Region of the Gulf.*—The atmosphere resting over the Gulf, and over its coasts, and the estuaries and deltas of its rivers, is constantly near the point of saturation; although from its high temperature, a large amount of vapor is necessary to that condition. Thus, the mean annual temperature of the thirtieth parallel, is seventy degrees, at which point, the quantity of vapor, which, according to the table, is necessary to the saturation of a cubic foot of air, is 0.8693; while at the thirty-ninth parallel, where the mean annual heat is 53°, the amount of vapor required to saturate the same quantity of air, is only 0.5074. Hence, around the Gulf, there is not only an impregnation of the atmosphere, nearly up to the point of saturation, but the absolute quantity of vapor is great. The dew point is always high, and its complement small. In every season of the year, the loss of a few degrees of temperature, is sufficient to cause the condensation of vapor, and render the air moist. When the wind blows over the interior of the continent from the Gulf, it brings with it this great amount of vapor; and coming into colder climates, which have a lower dew point, the atmosphere is at first made damp, then hazy, and at last rainy. During the winter, the heat of the Gulf keeps up, while that of the inland regions becomes greatly reduced; and in the spring, the winds from the former have their vapor condensed in passing over the latter, and hence the copious rains of that season. At midsummer, currents from the Gulf are still passing to the north; but the air over the continent is so hot, that it can receive and retain much of their vapor, in addition to what it already possesses. In autumn, the continental atmosphere is cooled, and then the southern currents send down, in the form of rain, a liberal quantity of their vapor. Hence there are vernal and autumnal floods in our rivers. If the Gulf of Mexico were filled up, the winds from that region would have a high temperature, with a low dew point, and would shed upon the interior but little rain—the condensation from the difference of temperature, would not reach the dew point.

2. *Region West of the Gulf and the Mississippi.*—The great inclined plain west of these waters, stands in opposition to the region of the Gulf. Its southern latitudes are as warm, as those of the northern curve of the Gulf; and even for ten or fifteen degrees further north, the summers are almost as hot as those of the latter region. The temperature is such as would admit of a high dew point; but the surface does not afford water for copious evaporation; and the air seldom approaches the state of saturation—is generally capable of receiving more vapor, and feels dry. The mountains to the west, are equally deficient in sources of vapor, and their low temperature causes the precipitation in the form of snow and frost, of so great a quantity, that the atmosphere over them has a dew point still lower, than the atmosphere of the plain. When the winds of the Gulf traverse that region, much of their vapor is required to bring its atmosphere to the point of saturation, and less is left to be precipitated in the form of rain or dew. On the eastern margin of the plain, near the Mississippi River, this is not the case, for the evapora-

tion from the broad and watery trough of that river, keeps up the atmospheric vapor; but on advancing toward the mountains, the quantity of vapor becomes so small, that it remains uncondensed during the minimum temperature of the summer night, and dew does not form. In autumn, however, when the temperature sinks still lower, saturation is reached, and vapor is then deposited in the form of hoar frost.

These facts disclose to us the cause of the dryness, and the drying quality, of our west, and north-west winds. The absolute quantity of their vapor is small, much less than, at their temperature, they are capable of containing; and hence, when they roll over the eastern half of the Valley, they take from it a large quantity of water. By the vulgar, their coldness is supposed to be the cause of their drying power, and hence they speak of freezing things dry; but if they came with the same small, absolute quantity of vapor, and had a high temperature, their drying power would be far greater. The winds which possess this power in the highest degree, are those which blow from a southern, sandy desert. They come with a low dew point, while their heat gives them a capacity for sustaining one much higher.

3. *Region East of the Mississippi, between the Gulf and Lakes.*—The geological, hydrographical, and botanical conditions of this region, conspire in affording more vapor to the atmosphere, than the region beyond the Mississippi. The south-west winds which traverse it, come from the Gulf, much oftener than those which traverse the more western plains. Finally, the north-east winds come almost saturated with vapor, afforded by Davis's Strait, the Gulf of St. Lawrence, and the Northern Lakes. Under such circumstances, its atmosphere is of necessity more humid, has a higher dew point, and a complement of shorter range, than the region to the west of the Mississippi, between which and the region of the Gulf, it may be regarded as holding an intermediate position.

4. *Region of the Lakes.* — Here is abundance of water, but the temperature, compared with that of the Gulf, is low; and the absolute quantity of atmospheric vapor is, of course, much less than along the shores of the Gulf. Hygrometric observations have not yet determined the relative number of degrees in the dew point, of these two different regions, lying thirteen or fourteen degrees of latitude apart. At Toronto,* the elastic force or tension of vapor, from observations every two hours for two years, was found to be 0.259 in., and the mean annual temperature for the same years was 44°.8. Now, by a reference to the table of tensions, we find that vapor of this temperature, when the air is saturated, has a tension of 0.313 in., showing that the atmosphere around the Lakes, taking the year throughout, does not approach the dew point.

At Hudson, nearly thirty miles south of Lake Erie, Professor Loomis† found the complement of the dew point for two years to be 8°.10, while at Toronto it is about 5°.25—difference 2°.85, in favor of Hudson, which is what might be expected from their relations to the Lakes.

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* Mag. and Met. Obser.

† American Journal of Science.

From the table of Professor Loomis, it appears that the month of April has the least vapor, compared with what, from its temperature, the atmosphere might contain. The complement of the dew point of that month, is 12°.80; that of December, which has the least, is 4°.95. Of the seasons, spring is the dryest, winter the most humid; summer and autumn are intermediate, and differ but little from each other. Two observations were made daily by Professor Loomis, one at nine, A. M., the other at three, P. M. The difference between them was, for the year, 5°.2. The greatest difference was in spring—the least in winter.

5. *Arctic Region.*—A reference to the general table of mean temperatures, and the table of this section, will show that the actual amount of vapor which can at any time exist in the atmosphere, within the polar circle, is very small. In the latitude of thirty degrees, where the mean temperature of the air is seventy degrees, it requires 0.8693 grains troy, to saturate a cubic foot of air. Under the fortieth parallel, which has a mean heat of fifty-one degrees, 0.4757 grains are required for saturation; at the seventieth degree of latitude, where the average annual heat is but five degrees, the required amount is only 0.0872 grains. In popular language, the vapor of the atmosphere is nearly frozen out. Still, in those regions, one of the chief inconveniences, experienced on shipboard in winter, was the humidity of the apartments. The atmosphere has no capacity for receiving the exhalations from the lungs and skin, which, being condensed against the walls, by reëvaporation, maintained the air at the dew point, while everything without, had its moisture congealed and deposited. When the wind blows from that region, it does not, however, reach the more southern latitudes, in such destitution of vapor; for, in traversing Hudson Bay, and a countless number of lakes, its temperature is raised, and it imbibes a great additional quantity of vapor.

III. Dew, Frost, Fog, Smoke-Fog or Indian Summer.—1. *Dew.*—A reference to *p.* 150, will prepare us for understanding, why there are two periods in the twenty-four hours, when dew is deposited more copiously, than in any others. Evaporation begins at sunrise, and goes on until the maximum heat of the day is reached, between two and four o'clock, P. M.; but with the increase of atmospheric temperature, comes an increase of capacity for holding vapor in a state of insensible suspension; and hence the air, and all the objects which it envelops, feel dry compared with the morning, although the quantity of vapor is greatly augmented. As the sun declines, and its rays develop less heat at the surface of the earth, cooling commences, and goes on in three modes: *First.* Evaporation continues in virtue of the heat of the surface, and carries off caloric in a latent state: *Second.* A portion of the surface heat is conducted into the earth: *Third.* Radiation continues, and is, by far, the most efficient mode of cooling. Thus the decline of atmospheric temperature begins at the surface of the earth, and when it has sunk until the vapor, at the lower temperature, begins to saturate the air, it becomes fresh and moist. This often happens before sunset; always, indeed, before that time in ravines and narrow valleys; for the sun ceases to act on them before it leaves the plains. As radiation is the chief cause of the cooling, it proceeds more rapidly from surfaces which are covered with objects which rise from the ground, as grass and trees, than from the earth itself. It proceeds slowly from water, for when the superficial stratum gives out its heat to the rising vapor, it sinks and the one immediately below comes up to the surface. As the decrease of temperature, from four or five o'clock to nine, is more rapid than for the remainder of the night, it follows, that a large part of the vapor, suspended in the hot air of the day, is thrown down as evening dew; and thus, by ten o'clock, the deposit on the leaves of our forest trees is often so great, that drops are formed, and can be heard falling from leaf to leaf. But dew does not appear on every evening in those seasons in which it prevails, for if clouds overcast the sky, radiation from the earth is, in part, compensated by radiation from the clouds, and the air near the surface is not reduced in temperature to the dew point; or the humid south or southwest wind may spring up and prevent the necessary cooling; or a dry northwest wind may absorb the liberated vapor. It is a popular opinion, that the vapor which arises during the day in summer and autumn carries up, in solution or combination, whatever noxious gases or miasms may be liberated at the surface of the earth, to return with the so-called *falling* dew; and hence the insalubrity of evening exposures in those seasons. Without adopting this opinion, we may admit the fact, that such exposure aids in the production of certain fevers; and find an explanation in the sudden transition of temperature from four to nine o'clock, and in the humidity which it occasions.

The second period in which dew may be copiously deposited, is the latter part of the night and at the dawn of day. After nine or ten, P. M., the rate of decrease in the temperature of the air is much diminished, and with it the deposition of dew; but when the minimum is reached, the deposition is increased. Sometimes we have morning dew only, the temperature in the evening not falling low enough to reach the dew point. Exposure to this dew, in traveling through tall prairie grass, or working in corn or cotton fields, has been found unhealthy. The cold wetting which it occasions, followed by a rapid increase of forenoon heat, may, perhaps, do the mischief; but if we admit that miasms may be deposited in dew, their ascent, with the vapor generated by the morning sun, will enable them to act on the systems of the exposed. The former is a fact—the latter a hypothesis.

The theory of dew, first developed by Doctor Wells, and briefly recognized in this section, discloses to us, that there is, over every spot, in spring, summer, and autumn, a circulation of the same water rising into the atmosphere through the day and returning at night, to reascend on the following day; yet the whole of it is not deposited, and in the absence of rain the earth continues to dry, which drying goes on much more rapidly over naked surfaces, than those which are covered with trees or rank herbage, which favor cooling and the deposit of dew; and hence a forest sustains a drought much better than a treeless plain with a scanty herbaceous vegetation.

2. *Hoar Frost* is dew congealed into crystals. It is found on objects which project a little from the earth, when it is not seen on the earth itself, because they radiate more freely, and their temperature is but imperfectly kept up by conduction from the earth. Thus a degree of cold which will deposit frost may not freeze the ground. What is, by the people, called a *black* frost, is the freezing of water at the surface of the earth, when the dew point is so low, that atmospheric vapor will not be deposited. Such a reduction of temperature is necessary in spring to freeze the vegetable juices, and in the autumn to arrest bilious and yellow fever. A copious white frost may appear without doing either. We sometimes see frost falling, in a winter-day, when the atmosphere is cloudless. In the intermixture of strata of air, some one has become saturated and gives out a portion of its vapor, which is congealed, and falls in minute crystals, rendered visible by reflecting the light of the sun.

3. *Fog* appears when the atmosphere over a watery surface is colder than the water—a condition the opposite of that which originates dew. The vapor, which escapes in quantities proportionate to the temperature of the water, saturates the air, and is converted into floating vesicles, or cloud. The action of the sun, by expanding the vapor, causes it to disappear. Fogs imply cool nights, and, the extent of watery surface being the same, they are denser, and occur more frequently in the higher than the lower latitudes, because the difference between the temperatures of the night and the watery surface, are there greater. Fogs appear but seldom along our rivers in spring and early summer, for the reason that the water has not yet acquired its highest heat. When that is reached, and the nights begin to cool, in the latter part of summer, they prevail and continue in autumn, until the streams are reduced in temperature to a certain point, when they cease. Their coincidence in season and locality with autumnal fever, has given rise to the opinion that they contribute to the production of that disease.

4. *Smoke-Fog, or Indian-Summer.*—An aspect of the atmosphere which occasionally shows itself for a brief period in spring, is an annual and protracted phenomenon, in autumn. For its popular name, Indian-Summer, I have proposed one, more expressive—Smoke-fog. In Europe a corresponding state of the atmosphere is denominated Dry-fog. In our Valley, the months of October and November are those in which this atmospheric phenomenon appears. Its duration varies from one to two, three, or even four weeks, in different years. It also varies in depth or intensity, in successive autumns. A copious fall of rain, sometimes mingled with snow, and followed by hard frosts, generally precedes its appearance. The atmosphere, during its continuance, is commonly, tranquil; temperate in heat, and hazy; but not much obscured by clouds. Falls of rain are, however, not uncommon; and in general, the whole appearance vanishes with a rain-storm, followed by a winter temperature. An apparent smokiness through which the sun and moon, when near the horizon, and especially in the evening, appear of

a crimson hue, is the great characteristic of the season. As the time when it occurs, coincides with the period of our densest river fogs, the nights and mornings in our valleys sometimes present a deep and gloomy obscuration; which exerts on the hypochondriacal a depressing influence; and, as opthalmia prevails more in autumn than any other season of the year, it is possible, that this state of the atmosphere may be an exciting cause.

The origin of Smoke-fog, is supposed by many to be unascertained; but the greater number think it dependent on extensive conflagrations, in our forests, where the ground is overspread with dead leaves; and on the extended prairies, interspersed with groves, through which the Mississippi holds its way; but, above all, on the immense desert which stretches off to the Rocky Mountains. The dryness of that region, leads to an early withering of its grass and herbaceous plants; and running fires are known annually to consume that which, allowed to accumulate, would at length increase the fertility of the soil. An objection to this opinion is drawn from the well-known fact, that rain does not permanently dissipate the Smoke-fog, which is often quite as great, the next morning after a copious shower, as it was immediately before. But we must recollect, that rains are local, and might be profuse in places remote from the scene of conflagaration, without including it.

The state of the atmosphere here described, does not appear to have any connection with a dew point; for, according to the observations of Professor Loomis, at Hudson, the dew point of October and November is nearly that of the year; nor with the weight of the air—for the observations of Doctor Engelmann and Doctor Ray show, that the barometer in October and November, has very nearly the average elevation of the twelve months; nor can it arise from volcanoes, for, although some of the mountains on the coast of the Pacific Ocean are volcanic, they are too far in the north-west, to spread their influence over the central parts of the Valley.

IV. THE DEW POINT CONSIDERED IN REFERENCE TO HEALTH.—When the complement of the dew point is small, or, in other words, the dew point is high for the temperature, whatever the latter may be, the air begins to be damp; when the complement of the dew point is reduced to nothing, and that point coincides with the temperature of the air, saturation exists and evaporation ceases. This condition may occur at any temperature; and hence, we may have a cold and moist air, or a hot and moist air. The latter is the condition of the shores of the Gulf of Mexico, for more than half the year—the thermometer ranging between eighty and ninety degrees, the air, at the same time, being nearly saturated with vapor. To this condition, many of our physicians have ascribed the fevers of the south; but without attempting to assign the *modus operandi*. Adopting, to some extent, the same conclusion, Doctor Lee* suggests, that such a state of the air retards the pulmonary excretion of carbon, thereby changing the condition of the blood, and throwing upon the liver the necessity of increased secretion. At the same

* Forry's Climate of the United States, p. 111.

time, cutaneous evaporation is impeded; and, in his opinion, the matters which the skin should excrete, are in part retained in the blood. Finally, a moist air conducts off the electricity of the body more rapidly than a dry. These effects he ascribes to a high dew point, and not to the great heat, with which, in the south, it is associated. But if saturation of the air with vapor, or the state approaching to it, can impair these functions, in warm climates, why does not the same cause produce the same alledged effects, in higher latitudes? We know, moreover, that the seamen of the Gulf of Mexico, who are immersed in an atmosphere nearly saturated with vapor, are little affected with fevers, while they keep at sea, provided their ships be not foul; but are apt to be seized, while in port. Lastly, it is well known, that the operatives in certain manufacturing establishments, spend their days in a hot, super-saturated, vaporous atmosphere, and yet enjoy good health. A hot climate, with a high dew point, is eminently fitted, however, to exert an influence in the production of the gaseous products of organic decomposition; and may, in that way, prove an indirect cause of fevers. In such a climate, everything, both animal and vegetable, which is dead, putrifies rapidly: while in colder or dryer climates, from lack of heat or of moisture, such decomposition goes on much more slowly.

A high dew point, with a low temperature, presenting coldness and moisture combined, is, perhaps, more injurious to health, than the condition just considered. Its influence in the production of tubercular phthisis, deserves to be considered. It doubtless favors the production of bronchial catarrh; and rheumatism is among its effects. Those who spend most of the day, and lodge through the night, in cellars, vaults, and cells with thick walls, are immersed in an atmosphere of medium temperature, kept constantly near the point of vaporous saturation. In such habitations, dyspepsia, chronic bronchitis, consumption, scrofula, and scurvy, are apt to occur; and may perhaps be ascribed to the humidity, and the absence, at all times, of a high temperature.

Our west and north-west winds, as we have already seen, have a low dew point, and are either temperate or cold. They are always invigorating, and contribute, in the end, to generate an inflammatory diathesis;—especially to produce inflammations of the lungs and joints. By their dryness, they promote a rapid evaporation from the skin and bronchial membrane. When of a low temperature, their chilling influence is so much increased by this rapid exhalation, that persons exposed on the prairies of Illinois and Iowa, are frozen to death, when the temperature of the air is not so low as to suggest the possibility of that event. If a person thus exposed, were to bury himself in snow, his body would soon be surrounded by a saturated atmosphere, when further evaporation would be suspended, and the danger of perishing diminished.

When the temperature is high and the dew point low, the action of the air is very powerful. It rapidly drys and hardens the ground, withers its plants by carrying off their juices, and exerts on men and animals all the bad effects of excessive evaporation, among which are dryness of the mucous membranes of the mouth, fauces, nostrils, and eyes. It is an observation of summer laborers in the field, that when they sweat freely, they can bear the heat; but if their skins remain dry, they are apt to fail. In this case, I suppose, the air has a low dew point, and carries off the transpiration of the skin, before it is condensed; and if so, they suffer from the dryness of the air, and not from being unable to perspire.

Of all portions of our Interior Valley, the southern and middle latitudes of the western prairies are most exposed to the fiery atmosphere we are now considering. At Fort Gibson, near the ninety-fifth meridian and thirty-sixth parallel of latitude, it has raised the thermometer to one hundred and sixteen degrees. On the same desert, from eight to ten degrees of longitude further west, and as far north as the thirty-seventh parallel, this state of the atmosphere exists in a still higher degree. The horse fly, and the green or pantry fly, are there unknown; and, in the month of July, the flesh of the bison, cut in slices and hung in the air, dries so rapidly as to be preserved without salt; and is carried to Santa Fe for future use. The optical phenomena of looming and mirage, are strikingly exhibited in the same hot and dry air. Small bodies are often seen in the distance, at a considerable elevation; and the delusive appearance of lakes and streams frequently tantalizes the way-worn and thirsty traveler.*

CHAPTER V.

ELECTRICAL PHENOMENA: DISTRIBUTION OF PLANTS AND ANIMALS.

SECTION I.

ATMOSPHERIC ELECTRICITY.—THUNDER STORMS.—HURRICANES.

I. Atmospheric Electricity.—It would be absurd to question the value, to a physician, of a thorough knowledge of the temperature, winds, weather, and moisture of the country in which he is to ascertain the causes, and prosecute the cure of diseases. If the study of its electrical condition and phenomena, cannot, in the present stage of our knowledge, be shown to possess an equal importance, it is by no means to be neglected. The mysterious, but apparently, intimate relations between light, caloric, magnetism, galvanism, and electricity, suggest that they are, perhaps, but one agent

* See Dr. Gregg's interesting Commerce of the Prairies, Vol. I, pp. 96–100

in different states or modes of action, the whole of which should be studied in connection. The manifest part which electricity plays in the systems of certain aquatic animals, as the *gymnotus electricus*, and the influence it may be made to exert on the nervous system of man, still further point to it as an agent, upon which the physician is bound to direct a portion of his attention. After the experimental demonstration, by our great countryman, Franklin, of the identity of electricity and lightning, by which the immense amount of that fluid in the atmosphere was made known, many physicians vaguely indulged the opinion, that it performs an important part in the animal economy. The subsequent discoveries of Galvani and Volta, gave a new impulse to these speculations; and suggested many experiments, on the effects of galvanic electricity upon the living body, both in health and disease. No satisfactory results have, however, been reached. The subject, nevertheless, is not likely to be relinquished by the imaginative; and, even the most sober-minded must admit, that an agent so powerful, so universally present, and so operative in many of the secret processes of inorganic nature, can scarcely fail to perform some important part in the living body. Perhaps the proper mode of studying it, in reference to that body, has not yet been discovered. That atmospheric air performed a vital part, in the kingdom of organized nature, was known from the beginning; but it was reserved for the last century to discover its mode of action. We are, perhaps, at this time, in a similar condition, in reference to electricity: and some future generation may devise instrumentalities, by which modes of action and effects, of which, at present, we can form no conception, will be rendered plain.

Electricity exists at the surface of the earth, and in the atmosphere at all times, and is forever circulating between them. Experiment has shown, that during combustion, the æriform products which escape are positively electrified, leaving the residuum negative; but the process by which the greatest amount of electricity makes its way into the atmosphere, is solar evaporation; the vapor, which arises from every wet or watery surface, in which any saline matter is held in solution, being positively electrified. Wherever, then, there is a high temperature with a high dew point, the atmospheric, electrical phenomena, are of a striking character; and where the temperature is low, and the evaporation feeble, they are correspondingly reduced. The condensation of vapor into fog, rain, or dew, appears to increase atmospheric electricity, setting it free, in conjunction, if we may so speak, with the latent caloric of the vapor. The tension or quantity of atmospheric electricity, as measured by the electrometer, is greater, in a tranquil state of the atmosphere, in winter than summer; it would seem that, as the vapor of the atmosphere is more and more deposited by increasing coldness, its electricity is disengaged and left behind. There is, also, a diurnal variation in the amount of electricity at the same place, when the weather is serene. According to Kaemtz:*

"At sunrise the atmospheric electricity is feeble; it continues to increase

*Complete Course of Meteorology, page 338.

as the sun rises, and the vapors are collecting in the lower regions of the atmosphere. This increasing period lasts, in summer, until six or seven o'clock in the morning; in the spring and autumn until eight or nine, and in the winter until ten or twelve o'clock in the day. By degrees the tension attains its *maximum;* during this time the lower regions are filled with vapors, the humidity of the air increases, and the hygrometric tension is stronger than in the morning; in the cold season there is often fog. Generally electricity decreases immediately after attaining its *maximum,* at first rapidly, then more slowly. The visible vapors of the lower strata disappear, the fogs disperse, the atmosphere becomes clear, and distant objects seem to approach the spectator. Toward two o'clock in the afternoon, the atmospheric electricity is very feeble, and scarcely stronger than at sunrise. It continues to diminish until about two hours before sunset; in summer until four, five, or six o'clock in the evening, and in winter until five o'clock. Its *minimum* lasts longer than its *maximum.* As soon as the sun approaches the horizon, it again begins to advance, increases sensibly at the moment of sunset, goes on increasing during twilight, and attains a second *maximum* an hour and a half or two hours after sunset. Then vapors form in the lower regions of the air, damp increases, and the night-dew falls. This second *maximum* usually equals that of the morning, but it continues a shorter time, and the electricity decreases slowly until the next morning."

I am not in the possession of any series of experiments on the electrical condition of the atmosphere, at any place in the Interior Valley. Two questions may be here proposed: *First.* What are the effects, if any, on the human constitution, of a highly positive or highly negative state of the atmosphere, and of the sudden transition from one to the other? *Second.* In what manner, if at all, does electricity contribute to the production or spread of epidemic diseases? I shall not undertake a reply to these questions, but dismissing the consideration of electricity as it exists in *equilibrio,* or a neutral state, say something of its phenomena and effects when in a state of perturbation.

II. THUNDER STORMS.—These electrical phenomena diminish in frequency and violence from the tropical to the polar regions. On the shores of the Gulf of Mexico they occur in every month of the year, but much oftener in hot than cold weather. In the middle latitudes, at St. Louis, their frequency has been observed and recorded, by Dr. Engelmann, for sixteen consecutive years. The mean of this long period was 49, distributed through the months and seasons as follows:

December,	0.60	June,	10.40
January,	0.69	July,	6.90
February,	1.25	August,	5.10
Winter,	2.54	Summer,	22.40
March,	2.60	September,	3.60
April,	5.70	October,	2.40
May,	8.30	November,	1.26
Spring,	16.60	Autumn,	7.26

We see by this table that, beginning with the season in which thunder-storms are least frequent, the order is winter, autumn, spring, and summer. In referring to the months we find a regular increase from December to June, and of decrease from the former to the latter. It is worthy of remark, that the extremes do not fall in the months of least and greatest *mean* temperature, which are January and July, but in the solstitial months, when the direct action of the sun is at its minimum and maximum.

Thunder storms become exceedingly rare as we approach the polar circle, in the northern part of our Valley. Ross, as far as I recollect, does not mention one at Boothia Felix, N. Lat. 70°, where he spent the greater part of three years. Simpson saw one in N. Lat. 68° 32′. Back speaks of one in latitude 68°, and says it was the most northern he had witnessed. Parry records one in latitude 66°, but none further north. We must recollect, however, that all these observations were made near or over the pole of cold, and that, in other meridians to the east and west, they probably occur in higher latitudes. For the Interior Valley we may assume the seventieth parallel as the zero for these electrical phenomena, which increase to forty-nine per annum, at St. Louis, in N. Lat. 38° 37′. The increase in the number is, perhaps, according to the square, or some higher power of the complement of the angle of incidence of the sun's rays, and is, therefore, constantly augmenting in quantity down to the Tropic of Cancer.

Our thunder storms, in every latitude, are more frequent in the day than night; but those of the latter period are often as violent as any which occur in the day. Occasionally they happen early in the morning, and are then generally repeated in the course of the day, or they usher in a steady rain. The most common time, however, is the afternoon, when they begin to form, during the period of maximum heat. A calm, or fitful breezes, precede them; the temperature is high, and the atmosphere, at the same time, is charged with vapor nearly to the point of saturation. The sultriness often becomes insupportable, and the feeling of lassitude very great. As the air and clouds are in a highly positive, electrical condition, that of the surface of the earth, and of the objects and animals resting upon it, must be in the opposite state, and hence, perhaps, arises a part of the langor felt while the storm is forming.

The first appearance of a thunder storm is generally to the west of the observer, on the Ohio. I have never seen one form further east than a few degrees from south. Around the Gulf of Mexico, they much oftener form to the east of south, for there a south-east wind corresponds to a south or south-west, in the middle latitudes.

Thunder storms are almost invariably accompanied by high wind; which, at the beginning, is generally from some point between south and west, but it has a strong tendency to veer toward the north; and, before the rain begins to fall, often changes to north-west; whence, in almost every instance, it blows at the conclusion of the storm, and often for a few hours afterward— its violence constantly diminishing.

Discharges of lightning from the cloud to the earth, are, I am convinced much more common in town than country. No summer ever passes, I suppose, without one or several houses being struck in Cincinnati, although there are many lightning rods. In traveling through our woods, in various parts of the Valley, I have often passed many miles without being able to find a single tree, scathed by lightning. The buds and leaves of trees, no doubt, act as attracting points, while their sap renders them good conductors; and thus the electricity is conveyed quietly into the earth; which, moreover, is generally moist under their shade. It is a popular opinion that the beech tree (*Fagus ferruginea*) is never struck by lightning. I have not, as yet, seen one which had suffered.

Particular spots, in city and country, have been observed to suffer more than others. Thus a part of Cincinnati, for a long while its north-western suburb, in former times, was peculiarly liable. I do not know how it is, compared with other parts, since it has been densely built over. In the year 1836, I was told by Mr. Potter, of Randolph, on the Mississippi River, in West Tennessee, that he knew of two plantations, which had suffered more than all other parts of the surrounding country.

Our steamboats are seldom struck by lightning. Many old commanders have assured me of this exemption. When at the Balize, in 1843, I was told by Captain Annable, of the Phœnix, who had been engaged for eleven years, in towing ships between the Gulf and New Orleans, that he had known ten or twelve ships struck, but not a single steamer. One of his most experienced pilots testified to the same exemption; and both state, that they had known ships to suffer from lightning, while steamboats, lying by their side, escaped.

Broad flashes of lightning, without thunder, are not uncommon in our hot summer evenings. There is sometimes the appearance of a low bank of clouds — but at other times, none are visible. These coruscations are always near the horizon, and may, perhaps indicate the summit of a thunder cloud, at such a distance as not to be seen, or its thunder heard.

The physiological effects of a thunder storm, are always considerable. They may, perhaps, be referred to several heads. *First*, a sudden reduction of temperature. *Second*, lowering of the dew point, and an increase in its complement. *Third*, an augmentation in the pressure of the atmosphere. *Fourth*, a restoration of the equilibrium, or neutral condition of the electric fluid. *Fifth*, the terror excited in most persons, by the near approach of a thunder gust, must not be overlooked, in recognizing its physiological effects.

An upward discharge of electricity, during a thunder storm, is not an uncommon event. When animals, in open places, remote from all elevated objects, are killed by lightning, the discharge is, no doubt, generally from the earth. But they are sometimes destroyed when near to such objects, while the objects, themselves, escape. Not long since, a horse and small carriage, with two men, were struck by lightning, in one of the streets of Cincinnati, while the high houses on either side remained untouched. Many years since, in that part of the city which has generally suffered most, I saw a bean-pole, which had been split by lightning, as far down as the surface of the ground. The fluid had probably been discharged from the earth through this pointed rod, and while passing along the moist extremity in the ground, did no mischief, but on reaching the dry shaft above, destroyed it. The following fact shows that electricity may be discharged from the earth, in flashes, without producing thunder. My informant, Judge Collier, of the Supreme Court of Alabama, was at Montgomery, and about eight o'clock, P. M., in the month of April, 1833, saw, with many other persons, repeated flashes, or electrical explosions, at the surface of the earth — which illuminated the surrounding objects, but produced no sound. Overhead there hung a black cloud, which sent forth a sound like that of low, distant thunder. A violent tempest immediately followed.

III. Tornadoes and Hurricanes. — These terms are commonly regarded as synonymous; but strictly speaking, they are not. A tornado is a limited thunder-storm, accompanied with a violent and destructive tempest. A hurricane is a wind of much greater extent and duration, attended with fewer electrical phenomena. Both occur in the southern and middle latitudes of the Interior Valley, chiefly in hot weather. According to Mr. Espy*, in every tornado, there is an imperfect vertical, or oblique vacuum, produced by columns of heated and ascending air, which aunulus moves forward; and at the same time, invites into it the surrounding air, near the surface of the earth, so as to establish centripetal currents. These currents, by their extreme velocity, prostrate, overturn, or transport the objects which lie in their way. But these ravages are not the greatest, which the tornado occasions when it passes over a town or city. At the moment when the imperfect vacuum reaches such a spot, the air in every house that is closely shut up, suddenly expands, and bursts out the windows, drives off the roof, or even throws down the walls. The older, and more current opinion is, that every tornado is a whirl-wind. The axis or center of a whirl-wind must, of necessity, be an imperfect vacuum, and when it passes over houses, or objects inclosing atmospheric air, the same destructive expansion must occur, as if the rarefaction were produced in the other mode; while the gyratory motion of the surrounding air, seems well-fitted to produce many of the devastations which render these storms so terrible. It is in our compact and lofty forests, that these ravages are most conspicuous. I have seen many spots which had been thus visited; some of which presented the fallen trees with their trunks generally in the direction of the path of the tornado, while others have presented them in all directions, indicating a gyratory motion. It is not uncommon, moreover, to see young trees, of tough fiber, with their tops apparently twisted off. It is worthy of remark, that these devastations are sometimes found in spots or areas, and not in long vistas; indicating, apparently, a bounding motion in the tempest. In hurricanes, or tornadoes of vast extent and progression, Mr. Espy supposes the area of the region over which the air is rarefied to be of great range, and sometimes to be disposed in a

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* Philosophy of Storms.

linear, instead of a circular form; constituted an elongated center, into which the air rushes from two opposite directions. The whole storm is progressive, as in the case of common tornadoes; and may move in the plane of rarefaction, or obliquely, or even at right angles to it. As in the case of tornadoes, the winds which, at the surface of the earth, reach the imperfect vacuum, immediately ascend, and in the upper regions roll off laterally to descend, and be again drawn inward. When this rarefied center passes over objects which contain atmospheric air, it expands, and they are destroyed, as in the case of tornadoes. By other meteorologists, however, a hurricane is regarded as a vast whirlwind, with a progressive movement, in the center or vortex of which the air is calm and rarefied.

The plan and objects of this work do not permit an extended account of our tornadoes and hurricanes, and I must be limited to a few brief notices. Their frequency and destructive violence over and around the Gulf of Mexico is well known. Very lately, the insular town of Key West was laid waste, and then inundated, by a hurricane; and the dangers of navigation around Cape Florida are chiefly from the same cause. When describing the Gulf (*p.* 39), a notice was introduced of a hurricane, which drove the waters of the Gulf over the lower part of the delta of the Mississippi. All the low and flat coasts of the Gulf are, indeed, subject to inundations from this cause. When we advance into the interior of the Valley, the same kind of storms still occur.

Reference has been already made, to the tornado of Natchez, in 1840, the track of which is marked on the topographical map, *No. VII.* Its course was from south-west to north-east; but the wind which blew in Natchez was from the south-east, setting into the annulus or rarefied center of the storm. It was the transit of that center, over the town, which laid it waste, and the destruction was produced by the expansion of the air shut up in houses. Of all which stood in the path of the hurricane, those only escaped, which had their doors and windows open. For six days before the storm, the weather had been hotter than in the corresponding period, for the preceding five years. On the seventh day of the month, that of the storm, the barometer sunk to 29.46, or .15 of an inch below the mean of the preceding six days.

"The seventh day" (says Dr. Tooley, from whose paper * the preceding facts are taken), "was ushered in densely overcast, and very warm, with a brisk wind at S. 4,† increasing at noon, and veering to the E. 5. At meridian, the south-western sky assumed a darker and more tempestuous aspect, the gloom and turbulence increasing every moment. At 12.45, the roar of the approaching storm began to be distinctly heard, the wind blowing a gale, N. E. 6. The roar and commotion of the storm grew more loud and terrific, attended with incessant corruscations and flashes of forked lightning. As the storm approached nearer, the wind veered to the E. 7. At 1.45, the storm-cloud assumed an almost pitchey darkness, curling, rushing, roaring

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* Espy on Storms, page 338. † Ten being the maximum velocity.

above, below a lurid yellow dashing upward, and rapidly approaching, striking the Mississippi some six or seven miles below the city, spreading desolation upon each side, the western side being the center of the annulus. At this time a blackness of darkness overspread the heavens; and, when the annulus approached the city, the wind suddenly veered to the S. E. 8, attended with such crashing thunder as shook the solid earth. At 2, the tornado, 10, burst upon the city, dashing diagonally through it, attended with such murky darkness, roaring and crashing, that the citizens saw not, heard not, knew not the wide-wasting destruction around them. The rush of the tornado over the city occupied a space of time not exceeding five minutes, the destructive blast not more than a few seconds. At this moment the barometer fell to 29.37.

"The quantity of rain that fell during the passage of the tornado over the city, was only .83 of an inch, holding in suspension so much mud and minute particles of leaves and other vegetable matter, as to be impervious to sight, and leaving a thick coating upon whatsoever it came in contact.

"The effects of the storm upon the leaves and buds of plants was in a manner to sear them, abstracting or destroying so much of their vitality, that such as did not die outright were crisped, and their growth so suspended, that it was for ten or more days, before they resuscitated and began again to grow. Some very thriving grape cuttings, in the garden of the writer of this paper, were killed, and the old vines stunted. Even the leaves of the succulent morus multicaulis, appeared as if an eastern sirocco had passed over them. A luxuriant arbor vitæ, in the writer's yard, appears blighted and dying. Fruit trees, grass, and weeds, put on the same appearance."

We learn from Professor Forshay (*loco citato*), that a thorough investigation of the desolations produced by this hurricane, resulted in the undeniable conclusion, that the houses were destroyed by the outward explosion of the air which they contained, at the moment when they were traversed by the annulus.

A tornado at Tuscaloosa, Alabama, occurred at six o'clock, A. M., on the 4th of March, 1842. Its devastations could be traced to the south-west, for more than forty miles, but not so far to the north-east. They were, however, not continuous, for, as Judge Collier informed me, spots lying in the path of the tempest, were uninjured, while others were devastated. Thus the base of the storm seems to have bounded on the surface of the earth. In a ride with Doctors Guild and Harrington, I saw the vista it had opened through a piece of woods. The fallen trees, almost without a single exception, lay with their trunks in the plane of the vista, with their roots to the windward, but those of the opposite sides of the path were inclined a little toward the central line or axis, as if they had been acted upon by lateral winds, driving inward, while the whole atmosphere was in a still more rapid movement forward. That portion of the town over which the hurricane passed, as Doctor Harrington and Doctor Guild assured me, suffered much more, in the following autumn, from fever, than other parts of the town, or than it had suffered previously, which they ascribed to the foul condition of the foundations of the demolished houses.

On the night of the first day of June, 1830, the southern part of Tennessee was visited by a hurricane, the general course of which was from south-west to north-east. The town of Shelbyville suffered more than any other. At that place, for several days before the storm, the air was calm, sultry, and oppressive. Early in the evening the wind began to blow, and clouds to form. For several hours the gale increased in violence and about midnight, a sudden destruction fell upon the town. Every house in the path of the storm, which had its doors and windows *open* was destroyed; those only escaped which were entirely *closed*, precisely the reverse of what happened at Natchez. The lightning was so incessant that all objects were constantly visible; but the sounds of falling houses were inaudible. At the distance of eight miles, an observer saw two red and glowing clouds approach and meet, when they seemed to descend upon the town. That was supposed to be the moment when the crash of houses happened. This tornado was but one of the destructive currents of the hurricane, for the village of Charlotte, at the distance of sixty miles to the north-west, and consequently at right angles to the general course of the hurricane, was nearly destroyed. The breadth of the gale was, indeed, estimated at a hundred miles.*

On Sunday, the 28th of May, 1809, a hurricane, more impetuous than has since occurred, passed over Cincinnati. I was neither qualified, nor prepared with instruments, to make all the observations, required to illustrate its origin and movements; but the following account, published a few years afterward, embraces some well-ascertained facts, that are not destitute of interest:

"For two or three days previous to that time, the wind was various, with a turbid atmosphere. On the morning of the 28th, it veered to the south, and blew with violence. During the forenoon, while the lower clouds were passing rapidly to the north, the upper were moving with equal velocity to the east; indicating a superior current, which traversed the course of the south wind at right angles. Before twelve o'clock, both strata of clouds were propelled eastwardly, and soon after, the west wind was perceptible at the earth's surface. By three-quarters past one o'clock, the sky was very much obscured, and a narrow whirl-wind, or tornado, of great force, swept impetuously across the eastern part of the town. It demolished a few old buildings, threw down the tops of several chimneys, and overturned many fruit and shade trees. The people in the center of the town had scarcely time to view this alarming operation, before their own houses were shaken to the foundations by another gale of equal violence; this was immediately succeeded by a third, which traversed the western part of the town, with augmented fury. By this last, a handsome brick edifice, designed for tuition, was blown down, in consequence of having a cupola disproportionate to its area; and various minor injuries of property were sustained — but the in-

* Dr. Kain in Amer. Jour. of Science, Vol. XXXI, page 252.

habitants escaped unhurt. A copious shower of rain and hail, with thunder and lightning, increased the terrific grandeur of the scene. Each of these tornadoes ascended the hill to the north-east of the town, forming a track through the forest, which remained visible for more than a year. Several veins of a similar kind passed over the adjoining country, both south and north, to the distance of a hundred miles. The same hurricane, as appears from the public journals, ascended the Alleghanies during the afternoon, and made its exit from the continent about eight or nine o'clock in the evening. To the south-west of this place, as far as the state of Tennesse, it seems to have occurred nearly at the same hour that it commenced here. Beyond that state, I have not been able to trace it. Mr. Henry Bechtle, who was on the Mississippi, in latitude thirty-three degrees, felt nothing of it on the 28th, but experienced, on the preceding day, a brisk southern gale; and I am informed by Governor Sargent that in the vicinity of Natchez, the 28th was fair, with moderate southerly breezes, which was the case for many days before, and several days after that, on which the storm occurred.

"From the history of this hurricane, although very imperfect, it appears—

"1. That it commenced to the windward.

"2. That it traveled about eighty miles an hour.

"3. That it was not derived from the Gulf of Mexico.

"4. That it was formed, about the same time, in the western parts of Ohio, Kentucky, and Tennessee, by the collision of two winds, the south and west; which, when combined, of necessity moved toward some point between north and east, with increased velocity and power."*

In referring to my meteorological register, for 1809, I find a few additional facts, which seem worthy of being introduced in connection with this brief and defective history. *First*, the haze for two nights before the storm, was such as to generate a halo round the moon; *second*, notwithstanding this obvious condition of the atmosphere, as to vapor, there was no dew on the morning of the 28th; *third*, this happened from the high temperature of that morning—75° Fahrenheit—which was 15° above any other morning of the month; and 20° above the three preceding mornings. This rise of temperature began with a south wind on the afternoon of the day before, when the mercury rose to 83.5; *fourth*, it is noted that windows were blown *inward*, and nothing is said of an outward blast. *Fifth*, wherever concentrated veins of this hurricane passed from the interior of Kentucky to the interior of Ohio, there was hail. A few miles north of Cincinnati there were two falls of that meteor. The first consisted of small, smooth, opake globules; the second of irregular lumps, as large as a hen's egg, having the appearance of common ice. *Sixth*, in several places, lying as it were between the tornado-currents, there was a thunder shower with hail, but scarcely any wind.

In connection with this hurricane, I may quote from the same work, *page* 114, a short account of a limited and not very violent storm, which produced on the leaves of plants an effect, almost identical with that described at Natchez, by Doctor Tooley.

* Pict. of Cincinnati.

"On the afternoon of the 4th of May, 1811, we experienced, from the same quarter with the hurricane just described, another of less violence; which was attended with some peculiarities worthy of record. The weather had been changeable throughout the earlier part of the day, and in the afternoon there was a fall of hail, with but little thunder or rain. The hailstones at this place, although misshapen, were of the ordinary size; but in the western part of the county, some of them were of surprising magnitude, and of many angular forms. Several weighed from eight to ten ounces each, and measured between fifteen and sixteen inches in circumference. It was perfectly calm when they fell, or much mischief would unqestionably have been done. The hail storm was followed by a moderate shower of rain, and a powerful blast from the south-west, in which many persons at Cincinnati felt currents or veins of air, heated to a very unusual degree. On the next day, the foliage of various plants was found to be destroyed. It was chiefly the leaves which grew to the windward, and were consequently most exposed, that suffered. They were neither lacerated nor wilted, but sustained an injury, which, upon exposure to the sun the ensuing day, caused them to wither. In some cases, only the tip of the leaf perished; in others, the whole was destroyed. Whether this extraordinary effect should be ascribed to heat, or to a noxious quality of the wind, is uncertain. I could not perceive that one species of plant was more affected than another; and of individuals, growing near the same spot, it was common to find only a part affected."

Professor Loomis* has given an account of two tornadoes which occurred in the north-eastern part of Ohio. The first passed over the village of Stowe, before daylight, on the 20th of October, 1837. The latitude of that village is 41° 12′, N. — its elevation above the sea about eleven hundred feet. In the evening there was a thunder shower. About three o'clock in the morning, a whirl wind formed, and moved rapidly from west to east, for three miles, with a breadth varying from forty to eighty rods. It produced the usual devastation. The trees on its outer parts had their tops directed inward, while those near the center of the track, had them turned more to the east. Many things were carried almost perpendicularly upward.

The second tornado, occurred in the same region, especially affecting the township of Mayfield, between four and five P. M., February 4th, 1842. Its course was E. N. E., and its length on land twenty-five miles, when it reached Lake Erie, and left no further traces of its progress. The sky was overcast with a dense canopy of black clouds, moving with great rapidity. "The progress of the tornado was marked by a huge column of a dull yellow, or smoky tinge," the lower part of which was dark and opake — the upper, semi-transparent. It lightened several times, and one tree was struck; but the quantity of rain and hail which fell, was small. Houses were lifted up, and many things carried to a great distance. An elaborate examination of their distribution, and of the position of the fallen trees,

* American Journal of Science.

satisfied Professor Loomis, and Professor St. John, of Western Reserve College, that a whirl wind really existed in this, as in the other storm. I cannot go into their details; but from the distance of this tornado north of the Gulf of Mexico, and its occurrence near mid-winter. a notice of it seemed necessary, to show the wide range of distribution which violent tornadoes have in the Interior Valley.

Professor Loomis* has given a tabular view of twenty-one tornadoes, of which fourteen were in the Valley; and has added the following interesting generalizations. *First*, that no season of the year is exempt from them; but that they are much commoner in warm than in cold weather. But one of the whole happened in winter, and but two in autumn. Of the fourteen which occurred in our Valley, one was in February, three in March, one in April, six in May, one in June, one in July, and one in October. It will be recollected that the Cincinnati tornado occurred in May; and after speaking of that which visited Natchez, on the 7th of May, 1840, Professor Forshay makes the following remark: "I find, by investigating somewhat, that strange coincidences have been happening here, in regard to hurricanes; and that we live in a region very much exposed to them. In May, 1823, and 1824, tornadoes traveled precisely the same track, with an interval, exactly, of a year. It is here confidently asserted, that they also occurred on the 7th day of the month. In 1832, on the same day of the same month, there was one at Kingston, fifteen miles from Natchez. The probable concurrence of the four storms is very curious."†

This concurrence, however, is not more remarkable, than the annual return, at Cincinnati, on or near the same day, of rainy and stormy weather, generally followed by frost—the last of the spring. From 1809 to 1815, seven successive years, there was rain in Cincinnati between the second and sixth days of May; generally accompanied with thunder and lightning; and sometimes with very violent wind. Occasionally, this spell of stormy weather, is posponed to the second week of the month. In the table of thunder storms, by Doctor Engelmann, we see that the number for May is greater than for any other month, except June. From all these facts, we perceive that, when the sun, in returning from the south, attains that elevation at noon, which belongs to the month of May, its power of exciting atmospheric agitations is very great; and, in reference to some of them, continues to increase to the summer solstice.

A *second* generalization from Professor Loomis' table, is, that a great majority of tornadoes occur in the day time, and especially between noon and sunset. A *third*, that they are always preceded by a high temperature. A *fourth*, that they are invariably accompanied by lightning and rain, and frequently with hail. A *fifth*, that they always move eastwardly, the mean of the whole being about twelve degrees north of east. A *sixth*, that their average breadth is about one hundred and twenty rods; length, fifteen miles; velocity of progress, when violent, about thirty miles an hour; dura-

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* Espy on Storms. † Ibid., p. 298.

tion of destructive violence, forty-five seconds. A *seventh*, that light bodies are frequently transported from three to twenty miles. An *eighth*, that very few human lives are lost. A *ninth*, that leeward roofs are generally taken in preference to windward. A *tenth*, that fowls are frequently picked of most of their feathers, and have their bones broken. An *eleventh*, that in passing over ponds or rivers, water is invariably raised in considerable quantity; showing that tornadoes and waterspouts are essentially the same.

SECTION II.

CLIMATIC DISTRIBUTION OF PLANTS AND ANIMALS.

I. General Views.—The distribution of plants and animals over the surface of a broad continent, with its lakes and rivers, may justly be regarded as the most unerring indication of its climate; yet the state of the earth's surface is not without its influence. In beginning this investigation, it will be advantageous, briefly to enumerate the various kinds of climatic and geographical influence.

Mean temperature determines the limit to the south and north of many organized bodies; but the extremes of winter and summer, exert, perhaps, a still greater influence; the duration of the latter, especially, proving favorable or unfavorable to the development of certain species.

The humidity or dryness of a climate determines the limits of a great number of both plants and animals, and often overrules the effects of temperature. Winds, clouds, and sunshine, doubtless have an influence, but not always, perhaps, very appreciable.

Elevation above the level of the sea, by its influence on temperature and humidity, may cause a deflection of the line of limitation; but there is reason to suppose that it may act in other, not very obvious modes, in attracting or repelling both plants and animals. The course of mountain chains, has been observed to exert an effect: thus, when they run from north to south, their influence is greater than when they range from east to west.

The soil has a manifest agency in the distribution of organized bodies, especially plants; which may be seen much further south or north, where the soil is congenial to them, than where it is not. On a similar principle, the presence or absence of their appropriate food, may determine a greater or less dissemination of animals.

The course and the character of the waters, of great rivers, often extend or restrain the dissemination of both plants and animals, particularly birds and fishes.

Finally, the art and enterprise of man, carry many plants and animals into uncongenial climates, where, by being protected and cherished, they at last get acclimated; and, undergoing certain modifications of physiology, become permanent denizens.

Thus the relations of organized beings to soil, climate, and food, present a problem often difficult to solve; but always of delightful interest, both to the physiologist and pathologist.

II. CLIMATIC GEOGRAPHY OF OUR NATIVE PLANTS.—1. On the western side of the Gulf of Mexico, a belt of low land stretches from the peninsula of Yucatan, to the delta of the Mississippi, gradually widening, as the Gulf coast trends to the north-east, and leaves the Cordilleras. This, within the limits of the republic of Mexico, is called the *tierras calientes*, or hot climates. The southern part of this belt, presents all the grand and luxuriant evergreen vegetation, of the tropical regions. This portion of the zone belt is closely pressed by the mountains, in the midst of which stands the city of Mexico. As we approach the mountains, the vegetation undergoes a change, similar to, but much more rapid than, that which occurs in traveling north. In the language of that great observer of nature,* "There are few regions in the new continent, where the traveler is more struck with the assemblage of the most opposite climates. All the western part of the intendancy of Vera Cruz, forms the declivity of the Cordilleras of Anahuac. In the space of a day, the inhabitants descend from the regions of eternal snow, to the plains in the vicinity of the sea, where the most suffocating heat prevails. The admirable order with which different tribes of vegetables rise above one another by strata, as it were, is no where more perceptible than in ascending from the port of Vera Cruz to the table-land of Perote. We see there the physiognomy of the country, the aspect of the sky, the form of plants, the figures of animals, the manners of the inhabitants, and the kind of cultivation followed by them, assume a different appearance at every step of our progress.

"As we ascend, nature appears gradually less animated, the beauty of the vegetable forms diminishes, the shoots becomes less succulent, and the flowers less colored. The aspect of the Mexican oak quiets the alarms of travelers newly landed at Vera Cruz. Its presence demonstrates to him that he has left behind him the zone so justly dreaded by the people of the north, under which the yellow fever exercises its ravages in New Spain. This inferior limit of oaks, warns the colonist who inhabits the central table-land, how far he may descend toward the coast, without dread of the mortal disease of the *vomito*. Forests of liquid amber, near Xalapa, announce by the freshness of their verdure, that this is the elevation at which the clouds, suspended over the ocean, come in contact with the basaltic summits, of the Cordillera. A little higher, near la Bandarilla, the nutritive fruit of the banana tree comes no longer to maturity. In this foggy and cold region, therefore, want spurs on the Indian to labor and excites his industry. At the hight of San Miguel, pines begin to mingle with the oaks, which are found by the traveler as high as the elevated plains of Perote, where he beholds the delightful aspect of fields sown with wheat. Eight hundred metres higher, the coldness of the climate will no longer admit of the vegetation of oaks; and

* Pol. Essay on the Kingdom of New Spain Vol II, p. 165.—Amer. ed.

pines alone there cover the rocks, whose summits enter the zone of eternal snow. Thus in a few hours, the naturalist, in this miraculous country, ascends the whole scale of vegetation, from the heliconias and the banana plant, whose glossy leaves swell out into extraordinary dimensions, to the stunted parenchyma of the resinous trees!"

2. Around the northern curve of the Gulf of Mexico, from the Rio del Norte to Tampa Bay, we have a native vegetation of a different kind, and less luxurious growth, where evergreens and deciduous trees and shrubs are mingled together. Many of the plants of this zone are limited to the coast, from preferring its saline soil and atmosphere, rather than from the necessity of a hot climate; but others advance into the Interior Valley; and by the limits to which they extend, indicate the climatic influence. I will cite a few, chiefly found near the Mississippi, or in the region to its east.

The long-leaved pine (*Pinus australis*) overshadows all the dry and sandy plains of Florida, and reaches to a certain distance into the interior of Alabama, Mississippi, and Louisiana. I have not seen it above the thirty-third parallel; but as it appears on the Atlantic coast as high as the thirty-seventh,* a change in soil, rather than of climate, arrests its higher extension up the Interior Valley.

The live oak (*Quercus virens*) which delights in a wet and fertile soil, has a partiality for the sea-coast. Along the Mississippi and Alabama Rivers, I have not met with it above the latitude of thirty-two and a half or thirty-three degrees.

The cypress (*Cupressus disticha*) constitutes the governing tree in all the swamps of the northern curve of the Gulf; and ascends its rivers, becoming gradually blended with more northern trees. In the thirty-third parallel, it becomes scarce; but occasionally shows itself to the thirty-seventh, where the Ohio joins the Mississippi.

The *Magnolia grandiflora*, abounds in the rich soils which are free from inundation; and is found from the Gulf to the thirty-third degree of latitude; but if protected from the winter, while young and tender, it will grow into a tree as far north as the thirty-eighth degree of latitude, and, perhaps, further.

The sweet gum (*Liquidamber styraciflua*) and the pecan (*Carya olivæformis*) are both southern trees, which abound in Louisiania; but decrease in number, become solitary, and are rarely seen above the thirty-ninth parallel. These specimens may serve for the tree vegetation; but I must introduce some of a different kind.

Missletoe (*Viscum verticillatum*) abounds on certain trees around the Gulf of Mexico; but is not, I believe, found to the north, beyond the fortieth parallel.

Cane (*Miegia macrocarpa*) overspreads the rich and wet lands of the lower Mississippi, where it attains the hight of thirty feet. Up that river to the thirty-sixth degree, it forms impenetrable brakes beneath the lofty cot-

* Michaux: Hist. des Arb. For. d L'Am. Sep. Tom. I.

ton trees; and extends, with diminishing size, nearly to the thirty-ninth. The furthest point at which I have seen it, is Maysville, Kentucky, in N. Lat. 38° 45′.

The long moss (*Tillandsia usneoides*) is hung in somber festoons from the limbs of the cypress and many other southern trees, which grow near the rivers, or in swamps, quite down to the Gulf of Mexico. On the rivers of Alabama, I have not seen it above the latitude of thirty-three degrees north; but on the Mississippi, half a degree higher.

The south differs from the interior in having fewer annual flowering plants, in proportion to the number of its flowering shrubs and vines. It also presents much less of grassy surface than we find further to the north.

3. We come now to the middle latitudes. A zone comprised between the parallels of thirty-six and forty-two, a mean temperature which ranges from fifty-eight degrees down to forty-eight degrees, Fahrenheit, is that which embraces the greatest variety of forest trees; and within which they generally attain the loftiest magnitude. The most common and conspicuous are, several kinds of oak (*Quercus*), ash (*Fraxinus*), walnut (*Juglans*), hickory (*Carya*), dogwood (*Cornus*,) elm (*Ulmus*), buckeye (*Æsculus*), the honey locust (*Gleditsia*), white flowering locust (*Robinia*), hackberry (*Celtis*), maples (*Acer*), beech (*Fagus*), the yellow poplar or tulip tree (*Liriodendron*), and the cotton tree (*Populus*). These trees and their associates, are all deciduous. They separate the magnolia grandiflora, live oak, pecan, cypress, cane, and long moss of the south, from the pines, firs, hemlocks, birches, and certain oaks, of the north. To the south, some of them do not advance further than the thirty-third parallel; others are found in hummocks as far as the thirty-second, and others reach the Gulf, through the delta of the Mississippi.

At the eastern extremity of the zone, where it meets the Appalachian Mountains, these trees are replaced by several species of pine and oak, with other trees which flourish in cool and rocky localities. To the west, it passes the Mississippi, and stops at the margin of the desert, with the exception, that a few species ascend the rivers of that great region.

To the north, the forests of the temperate latitudes extend to the further coasts of Lake Superior; and while all the species do not hold out to that latitude, others advance far beyond it.

Observations have not, however, been made in a sufficient number of places, in that inhospitable wilderness, to reveal the limits of all the species. The buckeyes (*Æsculus*) are among the most limited in northern extension. I have not seen them beyond the valley of the Cuyahoga, in N. Lat. 41° 15′; but Wright enumerates one species as a tree of Michigan,* which shows a more northern limit. The white flowering locust (*Robinia*) has not a high northern extension. It is not mentioned in the flora just quoted. The same is true of the blue ash (*Fraxinus*). On the other hand, the sugar-tree (*Acer saccharinum*) increases in size and number, after we pass the

* Geological Reports.

curve of mean temperature of the Valley — which is fifty degrees Fahrenheit, and ranges between the forty-first and forty-second parallels. Around the Lakes, up to Lake Superior, it is one of the most common trees, mingling itself, in the fertile soils, with birches, pines, and hemlocks; but Major Long does not mention it among the trees observed on Rainy River, between the forty-eighth and forty-ninth degrees of latitude. The sycamore (*Platanus*) has, perhaps, nearly the same northern limit with the sugar tree. The cotton wood (*Populus*), which grows at the mouth of the Mississippi, was seen by Major Long, on Red River, near the forty-eighth parallel. Finally, Mr. Drummond,* who spent some time at Cumberland House, on the Saskatchawan River, N. Lat. 53° 57′, has given a catalogue of the trees observed around that fur-trading post, in which, of all belonging to the forests of the temperate region, he mentions only an ash and an elm; adding, that he supposed he was there, at the highest northern limit of the genera to which they belong. The annual mean temperature of that latitude cannot be far from thirty-two degrees Fahrenheit, which may be that which limits the arborescent flora of the middle latitudes; while a mean temperature of seventy-two degrees imposes a southern limit; thus giving to the diversified forests of the middle latitudes a range of forty degrees of mean temperature.

4. The trees which characterize the northern regions, and are found intermingled with those of the temperate climates, at the junction of these zones, from the forty-fourth to the forty-eighth parallels of latitude, are chiefly birches (*Betulus*), the balsam poplar (*Populus*), arbor vitæ or white cedar (*Thuja*), juniper (*Juniperus*), larch (*Larix*), red, white, and tamarack pine (*Pinus*), and several kinds of spruce, fir, and hemlock (*Abies*). Most of these are evergreens; and thus, after traversing the zone of deciduous trees, we come in the north to forests of evergreens, which we had left in the south. The northern arborescent flora, commencing about the forty-third parallel, nearly ceases before we reach the polar circle. Even below the sixtieth degree of latitude, the number of species is greatly reduced, and those which remain are stunted. Dr. Richardson,† near the mouth of Nelson's River, about N. Lat. 56°, where, at the depth of a few inches, the soil is perpetually frozen, found few other forest trees, than spruces, larches, and poplars, all of a reduced size. About Fort Enterprize, N. Lat. 64° 28′ he saw stunted spruces and a few birches. In these hyperborean regions, however, there is some variety in the decline of vegetation. Along Mackenzie's River, near the Rocky Mountains, trees are found in higher latitudes than they grow further east. On the alluvial banks of that river, the spruce fir, which Dr. Richardson* regards as the most northern tree of the Valley, reaches the latitude of sixty-eight degrees, the canoe birch disappearing thirty or forty miles before. Willows are found at the very mouth of this river, as willows grow at the mouth of the Mississippi. On the BARREN

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* Hooker's Botanical Miscellany, Vol. I., p. 180.

† Narrative of a Journey to the Shores of the Polar Sea, page 446.

GROUNDS, to the east of Mackenzie's River, the tree vegetation was so limited, that Captain Back* and his party had to depend mainly on moss for fuel. Still, even within the polar circle, there are many small shrubs, which afford berries; and, also, a summer herbaceous vegetation, consisting of a limited number of species, which come to maturity by a rapid growth.

I must refer, for a moment, to the desert beyond the Mississippi. The aridity of its climate, and the very unequal distribution of rain throughout the year, much more than a difference of temperature, gives to this great region its vegetable peculiarities. To these meteorological influences, we may ascribe the comparative absence of many forest trees and succulent, herbaceous plants, which flourish in corresponding latitudes on the eastern side of the Mississippi; and to the same conditions we may refer the presence of the numerous artimesias, some of which are suffruticose, and constitute the fuel of the Indians; and of all the cactaceæ, except a single species — the common prickly pear — which are found in the Interior Valley.

Having taken an imperfect and rapid view of the relations between our climates, and a few of our native plants, I will proceed to say something of those which are cultivated.

III. CLIMATIC GEOGRAPHY OF OUR CULTIVATED PLANTS. — We begin as before, within the tropics:

The banana (*Musa paradisiaca*), constitutes the leading article of cultivation on the *tierras calientes* of tropical Mexico. I cannot speak of its northern limit.

Coffee has not, as yet, been introduced further north than the island of Cuba.

Sugarcane, which attains its greatest development in the torrid zone, is cultivated on the banks of the Mississippi, as high as the thirty-first degree of latitude.

Rice is chiefly planted below the thirtieth, but would succeed in a higher latitude.

Cotton is a profitable crop to the latitude of thirty-six degrees thirty minutes, and will sometimes ripen a degree and a half further north.

Maize, or Indian corn, produces three crops, in the course of the year, between the tropics. Its accommodation to climate is greater than that of any of the plants which have been mentioned. In the latitude of thirty-nine, it is sometimes bitten by early frosts; but will bear cultivation ten degrees further north. On Rainy River, in latitude forty-eight degrees thirty minutes, and at Pembina, on Red River, in forty-nine degrees, Major Long† ascertained that it had ripened, but the yield was small. At Fort Garry, a degree further north than Pembina, I am informed, by Captain Lefroy, it will not come to maturity. The mean annual temperature of Pembina cannot be far from thirty-eight degrees Fahrenheit; that of summer, from sixty-four degrees.

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* Arctic Land Expedition, page 356. † Second Expedition.

The sweet potato (*Convolvulus battatas*), belongs to the south, but may be cultivated in sandy soils to the fortieth or forty-first parallel.

The Irish potato (*Solanum tuberosum*), although, perhaps, a native of the south, has acquired a northern acclimation. Toward the shores of the Gulf of Mexico it is inferior in size, and amylaceous development; but improves in both as we go north, and in the latitude of forty-three or forty-four attains its highest perfection.

Wheat, according to Humboldt, cannot be profitably cultivated below an elevation of four thousand feet, in the latitude of 19° N. In the states around the Gulf of Mexico, ten or twelve degrees further north, a tolerable yield may be obtained, but the flour is inferior. As we advance into higher latitudes, this cereal improves both in the quantity and quality of its grain, and seems to attain its most perfect development in Michigan and western New York; where, in the forty-third degree of latitude, the mean temperature is about forty-six degrees of Fahrenheit. It has been successfully cultivated, however, at Fort Liard, on Mackenzie's River, in the sixtieth degree of latitude, as I am informed by Captain Lefroy. Thus it has a wider range than maize.

The orange tree is sometimes destroyed below the thirtieth parallel; but often ripens a sour fruit to the thirty-first, where, however, it is but little cultivated.

The fig produces well up to the thirty-third degree, beyond which it requires winter protection.

The pride of china (*Melia azederach*), flourishes, as a shade tree, to the latitude of thirty-three degrees, and might, perhaps, be introduced to still higher.

The peach, which but partially sheds its leaves in winter, around the Gulf of Mexico, ripens its fruit as far north as the forty-third parallel, but affords an uncertain crop.

The apple, on the other hand, attains but little perfection below the thirty-third degree but; improves as we advance northerly, to the limits of existing cultivation.

The citations which have been made, indicate the thirty-third degree of latitude as one which constitutes, more than any other, a climatic limitation to plants, both indigenous and cultivated. Thus the white flowering locust, buckeye, sugar tree, honey locust, blue ash, and apple tree, are rarely seen south of that degree; and the long-leaved pine, live oak, magnolia grandiflora, pride of china, fig, cypress, and long moss, are as rarely met with above that parallel. These facts indicate a sudden change of climate which, however, admits of explanation. The Cumberland Mountain, an outlier of the Appalachian chain, when it reaches the northern part of Georgia and Alabama, from the north-east, turns to the west, and traversing the upper part of the latter state, sinks to the general level of the country, in the north-western corner of the State of Mississippi; thus forming a rampart of hills, many of which are more than a thousand feet in hight, which ranges between the thirty-third and thirty-fourth degrees of latitude. On the opposite or western side of the Mississippi, in the same latitudes, are the Ozark Mountains, which traverse southern Missouri, cross the State of Arkansas, pass through the northern part of Louisiana, and lose themselves in the Llano estacado, or the Rocky Mountains, of which they may be regarded as a lateral shoot. Many of the Ozarks have an elevation of fifteen hundred feet. Now the distance between these, and the last extremity of the Cumberland Mountain on the eastern side of the Mississippi, does not exceed two hundred miles; and thus the northern curve of the Gulf is backed by a parallel range of highlands, through which there are no other openings, than those which give passage to the Mississippi and Arkansas Rivers. The country south of this range, from the western edge of Georgia, to the southern boundary of Texas, embracing the states of Louisiana, Mississippi, Alabama, and part of Florida, consists of an amphitheatric series of alluvial, diluvial, tertiary and cretaceous plains, having a gentle, southern declivity, which constitutes the *tierras calientes* of the northern arc of the Gulf. It is not until the traveler from higher latitudes, has passed the northern boundary of this amphitheater, until he has descended below Memphis, and the mouth of the Arkansas River, that he realizes, by a change in the aspect of vegetation, that he has entered a new climatic region.

Thermometrical observations have not yet been made, with sufficient exactness, to determine the extent of this change of climate; which, however, is made manifest, almost as much by disease as by vegetation. In every fertile and well inhabited portion of the country, to the south of this hilly rampart, the diseases have more of a southern character, than to the north. Passive congestion largely takes the place of inflammations; and malignant intermittents and remittents occur with greater frequency. Yellow fever, which has repeatedly prevailed in almost every town up the Mississippi, to Vicksburg, in N. Lat. 32° 24′, has never, but once, reached Memphis, in latitude 35°, and has not prevailed at any intervening town. Thus its limits, on the whole, have been those of the live oak, cypress, and long moss; and it will not, any more than they, be found among apple orchards, wheat fields, and groves of blue ash, sugar maple, and the arborescent buckeyes.

IV. Climatic Distribution of our Animals.—The influence of climate on animal life, constitutes the end for which a physician studies the meteorology of the country in which he labors. To understand this influence, it is not sufficient to consult his thermometer, hygrometer, and other instruments of science; but he must also look at the species and habitudes of animals which live upon its surface, or in its seas, lakes, rivers, and atmosphere. In doing this, he will find that climate, in addition to its direct, has an indirect effect on the distribution of animal forms; through its influence on the growth and dissemination of plants, which constitute the food of the greater number of animals, especially those which are the prey of the carnivorous.

The limits of this work do not permit a full exhibition of the modifications of animal form and physiology, which the different climates of the

Valley present; while, on the other hand, it would be imperfect, without the notices which I am about to introduce.

Dr. John Richardson, in his admirable paper on North American Zoology,* has lucidly pointed out the great geographical and hydrographical features of the continent, which coöperate with climate, in extending or restricting the range, or determining the species of our animals. With these aspects the reader is already so well acquainted, from the descriptions of *Part I*, that a bare enumeration of them will be sufficient for our present purpose.

1. The general course of our mountain chains, is from south to north; from which it results, that the quadrupeds of the Valley, by obliquely ascending their slopes, may continue their migrations to a much lower latitude, than would otherwise be practicable; while those which inhabit the mountains are, also, invited into southern latitudes by the same reason. This is quite analogous to what we observe of various plants, as the apple, wheat, and other cereal grains; which, passing by the plains that surround the Gulf, are found on the terraces and table lands of Mexico, within the tropics.

2. The course of our great rivers, the Mississippi, the Nelson (including Red River of Lake Winnipeg), and Mackenzie's River, the first of which flows to the south, the two others to the north. These rivers not only invite many fishes beyond the latitudes to which they would otherwise have been confined; but, also, promote the migration of certain birds into climates which they would not have entered.

3. The vast grassy plains, which stretch from near the mouth of the Rio del Norte, to the mouth of Mackenzie's River, through more than forty degrees of latitude, without being interrupted by a single deep and impassable gorge, an herbless desert or a transverse range of mountains, greatly favor the wide range of our quadrupeds.

4. The vast number of lakes which lie above the forty-second parallel of latitude, together with the inland sea, called Hudson Bay, favor the northern extension of birds of passage; and, no doubt, increase the number of those which would traverse the continent from south to north, if its whole surface were as dry as the plains to the west of the Mississippi River.

In attempting to indicate the climatic distribution of the animals of the Interior Valley, I find the stock of materials exceedingly deficient. For its northern portions, the observations of Dr. Richardson are sufficiently ample; but, for the middle and southern divisions, there is no corresponding source of information. Neither the *Fauna Americana* of the late Dr. Harlan, nor the *American Natural History*, of my lamented friend, and former colleague, Dr. Godman, supplies the facts which are needed; the local fauna, attached to our state geological surveys, are but few, and they unfinished; finally, the books of scientific travels, which have been published, relate chiefly to the middle and northern latitudes of the Valley.

In the meagre notices I am about to give, I shall commence with the mammalia.

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*Sixth Annual Report of the British Association, page 121.

Of the animals which are classed next to man, a single species of monkey was found, on the western side of the Gulf, as far north as the twenty-ninth degree of latitude.

Of the bat tribe, one species ranges from the Arkansas River to the Great Slave Lake. I cannot give the range of the other species.

Of bears we have three species. The black bear (*Ursus Americanus*), is found as a resident of every climate of the Valley, from south to north. The grizzly bear (*U. horribilis*), inhabits the Rocky Mountains, perhaps through their whole extent. The white or polar bear (*U. maritimus*), lives on the ices of the Polar Sea, and the coasts of the adjoining continent. This animal is the most northern of all our quadrupeds, having been seen, by Captain Parry, as far north as the eighty-second degree of latitude, and never coming further south than the fifty-fifth degree, on the coast of Labrador.

The raccoon (*Procyon lotor*), ranges from the Gulf of Mexico, to the sixtieth degree of latitude.

The badger (*Meles Labradoria*), is found on the prairies, up to the fifty-fifth parallel. Of its southern limit I cannot speak.

The common weasel (*Mustela erminea*), the mink (*M. lutreola*), and the skunk (*Mephitis Americana*), are found from south to north.

The otter (*Lutra Brasiliensis*), inhabits from the Gulf of Mexico to the Polar Sea.

The wolf (*Canis lupus of Lin.*), resides from Florida to the arctic circle. The red fox (*C. fulvus*), is found in every latitude. The swift fox (*C. velox*), does not live further north than the fifty-fifth parallel. The gray fox (*C. cinerius*), is found from Canada to the south. The arctic fox (*C. lagopus*), ranges as far south as the fifty-eighth parallel.

The cougar or panther (*Felix conchdor, L.*), inhabits the southern and middle latitudes of the Valley, extending north to Upper Canada.

The opossum (*Didelphis Virginiana*), ranges through the same latitudes.

The beaver (*Castor fiber*), ranges from the latitude of thirty-five or thirty-six degrees, to the most northern woodlands.

The prairie marmot or "prairie dog" (*Arctomys ludovicianus*), inhabits the great plains, in their southern and temperate latitudes.

The common gray squirrel (*Sciurus Carolinensis*), is found from the lakes to the Gulf of Mexico.

The common rabbit or hare (*Lepus Americanus*) is seen from the Gulf of Mexico to the limits of the northern woods.

The mountain goat (*Capra Americana*) and mountain sheep (*Ovis ammon*) inhabit the Rocky Mountains throughout their entire range.

The antelope (*Antilope furcifur*) ranges on the plains near the Rocky Mountains, from the Saskatchewan, in N. Lat. 54°, perhaps to the Rio del Norte.

Our common deer (*Cervus Virginianus*), is found from the gulf shores to those of Lake Superior. The elk (*C. Wapiti*) ranges as high as the fifty-fourth parallel. The moose (*C. alces*) lives high in the north, and does not migrate below the latitude just mentioned. The reindeer (*C. tarandus*) is the most northern of our ruminating quadrupeds—being found in summer on the islands of the Polar Sea; in winter, in the valley of the Saskatchawan, about the same latitude with the moose.

The musk ox (*Bos moschatos*) inhabits, and is peculiar to, the *Barren Grounds* between Hudson Bay and the Coppermine River. In summer it migrates north to Parry's Islands, in latitude seventy-four degrees.

The bison or buffalo (*Bos Americanus*) formerly inhabited Florida. It extends north to the sixty-second degree of latitude. Is almost confined to the prairies, and does not range nearer to Hudson Bay, than six hundred miles.

It appears from these citations, that a large proportion of our quadrupeds have a wide climatic range across the continent, the result, no doubt, of the unbroken continuity of the Rocky Mountains and the great plains which lie to their east. Animals, which might have begun in the temperate latitudes, have gradually advanced and become acclimated in more southern or more northern climates. The latter, especially, have invited them, and given to the cold regions, a fauna, richer in large quadrupeds, than the warm—thus reversing the order of our arborescent flora. This truth is made still more obvious, when we refer to the marine mammalia of the south and north. In the Gulf of Mexico, there is, I believe, no species larger than the common porpoise (*Delphinus phocæna*), which may be occasionally seen vaulting up the *passes*, or ultimate mouths of the Mississippi; but the Polar Sea, which subtends the northern extremity of the Valley, abounds in seals, dolphins, walrusses, and whales of the largest size. The first, supplies the chief articles of food, clothing, and fuel, to the tribes of Esquimaux, who inhabit those desolate regions. Thus, so great is the range of our climates, that at one extremity of the Valley, man draws his subsistence and comfort from the vegetable kingdom — at the other, from the animal.

For what relates to the climates sought by the following birds, I am indebted to Doctor Richardson, Mr. Nuttal, and the distinguished American ornithologist, Audubon. Most birds are migratory, under the combined influence of food and climate. In autumn, there is a movement to the south — in spring, to the north. Some species migrate through a few degrees of latitude only — others quite through the Interior Valley. Those birds which do not change their latitude to any great extent, wander from place to place in quest of sustenance. It is extremely difficult to ascertain the precise limits of migration, which, in fact, may differ in different years, according to the well-known annual variations of climate, and the food on which different species subsist.

The wild turkey (*Meleagris gallopavo*) is essentially a bird of our middle latitudes; being rare near the Gulf of Mexico, but formerly abundant in Kentucky, Ohio, and the states lying to their west. It ranges the Mississippi and Missouri, in the woodlands, as high as Lat. 44° N.

The purple grakle (*Quisculus versicolor*) is found, all the year round, in Louisiana; in summer, on the shores of the Lakes, and beyond to Lat. 57° N.

The turtle dove (*Columba Carolinensis*) breeds in Louisiana, and in summer spreads over the country to the Lakes, in Lat. 42° N.

The mocking bird (*Turdus polyglottus*) is found, throughout the year, in Louisiana, and in summer, makes its way as far north as the Lakes, in Lat. 44°.

The purple martin (*Hirundo purpurea*) arrives at New Orleans, from the south, in the first week of February, and reaches the banks of the Ohio from the 15th of March to the 15th of April, according to the opening of spring; advancing, with the hot weather, up to the fifty-seventh degree.

The humming bird (*Trochilus colubris*) appears in Louisiana from the more distant south, between the fifteenth of April and the first of May. It finally reaches the fifty-seventh parallel.

The wild pigeon (*Columba migratoria*) migrates over a wide range of country. In autumn, descending to the tropical regions — in spring, to Lat. 62° N.

The wild goose (*Anser Canadensis*) migrates from the Gulf of Mexico to Lat. 68° N. The same is true of the great heron (*Ardea herodius*) as to the south, but it goes no higher north, than Lat. 50°.

The ox-bird (*Tringa alpina*) ranges from the south-western coasts of the Gulf of Mexico to Mellville Island, Lat. 74° N.

The woodcock (*Rusticola minor*) comes up from the south, and extends its migrations to the St. Lawrence.

The rail (*Rallus Carolinus*) ranges from the south to the sixty-second degree of latitude.

The coot (*Fulica Americana*) extends its migrations to Lat. 56° N.

The parakeet (*Psittacus Carolinensis*) is a bird of the south. The highest latitude to which it migrates is about forty-one degrees north, on the Illinois River, where I saw it in the month of August.

The snowbird (*Fringilla hyemalis*) and the snow bunting (*Emberiza nivalis*) are northern birds, which, in severe winters, make their way far into the south. The former ranges between 55° and 30° N.; the latter between Lat. 60° and 36° N.

The raven (*Corvus corax*) is found from near the Tropic of Cancer to Lat. 74° N. The crow (*C. Americanus*) resides throughout the year, in every latitude, up to the fifty-fifth degree.

The kingfisher (*Alcedo alcyon*) inhabits every latitude, from the tropics to the sixty-seventh parallel.

The quail (*Ortyx Virginiana*) resides permanently from the Gulf to Lat. 48° N.

The blue bird (*Sialia Wilsonii*) is found, in mild weather, from the tropics to the forty-eighth parallel.

The meadow lark (*Sturnella ludoviciana*) is found from the hottest regions, up to N. Lat. 53°.

Of our reptiles and amphibious animals, I must say still less, than of our birds. As a general fact, our venomous snakes are chiefly in the south. The banks of every marsh and hummock, around the Gulf of Mexico, are infested with them; while they are not thought of by the traveler, who encamps on the shores of Lake Superior; yet several snakes, chiefly innoxious, are found as high as the fifty-fifth parallel. Lizzards reach only the fiftieth; but certain frogs and salamanders are found on Mackenzie's River, in the latitude of sixty-seven degrees. The alligator (*A. lucius*), which abounds along the estuaries around the Gulf of Mexico, ascends the Mississippi, and is sometimes found in the Arkansas River,* as high as the thirty-fourth degrees of latitude. Thus, its migration terminates near the line which bounds the magnolia grandiflora and the long moss.

Of the distances to which the fishes of the Gulf and the lower Mississippi, make their annual migrations into the interior, I cannot speak. The brook trout (*Salmo fontinalis*) is not found in the south. In traveling up the Mississippi, it is not met with, I believe, until we pass the forty-fourth parallel of latitude. Above that parallel, in the country around the mouth of St. Peters' River and the Falls of St. Anthony, I am informed by Dr. Shumard,† it is abundant; and becomes still more common as we advance higher in the north. The elevation of the streams above the sea, where the trout of this region begin to make their appearance, is about eight hundred feet. In the State of Ohio, according to Doctor Kirtland,‡ they are found in two streams which fall into Lake Erie, from table lands which have an elevation of eleven hundred feet, in the latitude of forty-one degrees thirty minutes. From these localities eastwardly to the mountains, trout are taken from many streams, at an elevation of twelve or thirteen hundred feet. The most southern latitude in which, so far as I have been informed, they have yet been found, is the thirty-ninth, at an elevation of fourteen or fifteen hundred feet, in some of the tributaries of the Monongahela River.

The *Salmo amethystes*, or Mackinac trout, and the *Corregonus albus*, or white fish, are found as low as the forty-first parallel in Lake Erie, and, thence indefinitely to the north.

The last animal of which I shall speak, and the only one taken from the numerous class of insects, is the musquito (*Simulium*). Along the lower Mississippi and its tributaries, especially below the latitude of thirty-three degrees, this notorious little insect lives and multiplies, throughout the winter; but in the middle regions of the Valley, it appears only in summer and early autumn. It was once supposed that these regions constituted its northern limit; but we now know, that travelers to the sources of the Missouri, and to the mouth of Mackenzie's River, find them a great annoyance. If the same species extends from the tropics into the polar circle, it affords a striking example of animal accommodation to climate; but it may be that a new species, in the north, is substituted for that of the south.

A few words must suffice, in this place, for the relations between climate and our domestic animals. Both the flesh and the milk of the cow degenerate, below the latitude of thirty-three degrees; that is, where the mean an-

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* Flint's Hist. and Geog. Miss. Valley. † U. S. Assist. Geologist.
‡ Ohio Geol. Reports.

nual heat is sixty-five degrees, or above. The mule, taken into the same region, maintains a constitution unimpaired. The horse, however, undergoes an acclimation; and for the first year, is weak, and has but little endurance. If he live through that period, his health and strength become good. The horses bred around the Gulf, are, in general, small, but hardy. Those which run wild on the southern portions of the great desert, are commonly of smaller size, than the domesticated. When sheep are taken into the southern part of the Valley, their wool degenerates. The hog, however, flourishes in the south, not less than in the temperate and northern latitudes.

It remains to speak of the dissemination of the human race through our various and opposite climates; but that will fall more properly into the opening chapter of *Part III*, for which we are now prepared; and I will only remark, here, that man has accommodated himself more effectually to all our climates, than any other member of the animal kingdom; being a *permanent* inhabitant of the whole, from the southern shores of the Gulf of Mexico, where the mean annual temperature is eighty degrees, to the latitude of seventy degrees north, where it is but five degrees of Fahrenheit. It appears, then, that he may become a permanent denizen of any region that will afford him sustenance.

PART THIRD.

PHYSIOLOGICAL AND SOCIAL ETIOLOGY.

CHAPTER I.

POPULATION.

SECTION I.

DIVISION INTO VARIETIES.

The Interior Valley of North America, embraces four of the five varieties, into which naturalists have commonly divided the human race. In reference to their numbers, civilization, and interest to the physiologist and physician, they stand in the following order: *First*, the Caucasian; *Second*, the African; *Third*, the North-American Indian; *Fourth*, the Mongolian. The three former, existing in contiguous or intermingled masses, present opportunities for studying the comparative physiology and diseases of different races, which we should not neglect. The last, known under the name of *Esquimaux*, are but a handful, compared with either of the other varieties, and live contiguous to but one of them — the Indian.

The Caucasian races are found in large numbers, within the tropics, to the latitude of forty-seven degrees north. Beyond that latitude, they are met with but in trading establishments, missionary stations, and other small settlements, on the rivers and shores of Hudson Bay, and Davis' Straits, up to the fifty-eighth or sixtieth degree. The most populous zone is between the thirty-fourth and forty-fourth degrees; the line of greatest length and density of population being near the latitude of thirty-nine degrees. A great majority of the whole reside east of the Mississippi.

The African, or Negro variety — nearly all of whom are natives of this continent, though many were born out of the Valley — have a more southern residence. Extending upward from the tropics, they gradually become more numerous in proportion to the whites, to the latitude of thirty-two or thirty-three degrees; when they begin to decrease, and above the thirty-ninth degree are found chiefly in large cities; though single families, or small settlements, are to be met with, beyond Lake Erie and Lake Ontario, as far north as the latitude of forty-four degrees. Like the whites, they are most numerous on the eastern side of the Mississippi.

The North-American, or Indian variety, on the other hand, nearly all reside west of the Gulf of Mexico and of the Mississippi, up to the forty-fourth degree of latitude; beyond which they are found over the interior of the continent generally, but are much more numerous to the west than east. After passing the fiftieth parallel, the number diminishes rapidly, and very few are found within the Polar Circle.

The Mongolian variety, of which the Esquimaux are the representatives, succeed in the north to the Indian, and are found on the entire polar margin of the Valley.

Intending to make the diseases of the African, Indian, and Esquimaux varieties, respectively, the subjects of special dissertations, I shall dismiss them, until the history of the diseases of the Caucasian races is finished.

SECTION II.

CAUCASIAN VARIETY.—HISTORICAL, CHRONOLOGICAL, AND GEOGRAPHICAL ANALYSIS.

I. Curves of Migration from Europe. — Western Europe, either directly or indirectly, has given our Valley its Caucasian population. The emigrating zone of that continent, extends from the south of Spain, in latitude thirty-six degrees, to the middle of Sweden and Norway, in the sixtieth parallel; and the emigrants from it have settled chiefly between the eighteenth and forty-eighth degrees. The principal emigration, however, has been from the region lying between the forty-fifth and fifty-fifth parallels; to that part of this continent comprehended between the thirty-fifth and forty-fifth degrees. Thus, the curve of emigration bends southwardly, and in traversing the Atlantic Ocean, has sunk, on an average, ten degrees to the south. The different lines of emigration, have, moreover, not often crossed each other; and hence, those who resided furthest north in Europe, now reside furthest north in America. The greatest exception to this remark, was the emigration of the French to Canada, while the English, from a higher latitude, were emigrating to Virginia and the Carolinas. On the other hand, the Spaniards, from the southern shores of Europe, settled around the Gulf of Mexico; and the existing emigration from beyond the Baltic, is to the regions west of Lake Michigan. Let us now look at these migrations in the order of their occurrence.

II. The French.—The beginning of the settlement of our Valley was in the North, and the first immigrants were French. As early as 1506, only fourteen years after the discovery of America, they had made a map of the Gulf of St. Lawrence, and in 1534, Cartier entered the St. Lawrence river. In 1535, he ascended it to the island of Montreal. After a long period of suspended operations, Quebec was founded by Champlain, in 1608. Emigration from France was then recommenced, and continued through the St. Lawrence, for more than one hundred and fifty years; that is, till Canada was ceded to Great Britain, in 1763. The settlers planted themselves on either bank of the St. Lawrence and its tributaries; and extended along the Lakes, chiefly upon their northern shores and intervening straits, to Mackinac and Lake Superior; always arranging themselves in open villages. In 1674, Father Marquette, and M. Joliet, a trader, entered the basin of the Mississippi, by Wisconsin River; and soon afterward their countrymen began settlements, which, at length, spread as far south as the latitude of thirty-eight degrees. Peoria, Cahokia, and Kaskaskia, in the western part of the State of Illinois; Carondelet, St. Charles, and St. Louis, on the opposite side of the Mississippi, in the State of Missouri; Vincennes, in the State of Indiana, and Fort Du Quesne — now Pittsburgh — are among the fruits of this early enterprise, among the upper and eastern tributaries of the great river.

A few facts connected with this, the earliest colony of our Valley, belong to its medical history. *First.* The pursuits and modes of life of the immigrants and their descendants, have always been remarkably simple. *Second.* They have not dispersed and intermarried, to any great extent, among the immigrants from other parts of Europe. *Third.* Their long canoe voyages up the great lakes and their tributary streams, gradually produced a peculiar class of men, generally called *Voyageurs*, of whom more hereafter.

At the present time, the chief portion of our northern French population is found, as indeed it has always been, in Lower Canada.

In 1683, De La Salle undertook to descend to the mouth of the great river, discovered by Father Marquette. This he accomplished, and returning by the same route, departed for France; where he promoted a southern emigration. Appointed to the command of the first expedition, he missed the mouths of the Mississippi, the object of his voyage, and landed, in 1685, on the shores of Matagorda Bay, in Texas, where he built Fort St. Louis. In 1687, he was assassinated by one of his own men, and no permanent settlement followed. In the same year, Tonti, from Canada, descended the Mississippi to Arkansas River, on which he established a post. After the unsuccessful expedition of La Salle, nothing more was done by sea, until 1699, when a settlement, under M. D'Iberville, was effected, on Biloxi Bay, whence excursions were made into the interior. In 1717, New Orleans was founded by the same leader. Colonists continued to arrive, and the Mississippi was ascended, until the settlements on the Illinois River were reached; and thus a curved zone of French population, extending from the estuary of the St. Lawrence to that of the Mississippi, traversed the great Valley, through seventeen degrees of latitude; before any other European inhabitants had entered it, except a few Spaniards in the south. In addition to their settlements on the Mississippi, the French made others, to a more limited extent, on the Arkansas, Red, and Mobile Rivers; in all cases confining themselves to the banks of the streams. A small and often interrupted current of immigration, continued until 1769; when Louisiana passed into the possession of Spain. Several years before that event, a considerable colony of French migrated from Arcadia — Nova Scotia — and settled on that part of the Mississippi, which is called the Arcadian Coast.

The French of the lower Mississippi, and their descendants, called Creoles, like their brethren on the St. Lawrence, lead simple, and, in the main, temperate lives; their pursuits are chiefly agricultural and commercial; they intermarry with the surrounding population rather more than those of Canada.

It would be interesting to trace out the influences of climates so distant, and soils so different, as those of Quebec and New Orleans, on people of the same national blood; but my intercourse with them has been too limited to justify the attempt.

III. The Spaniards.—In 1528, the Spaniards, under Narvaez, effected a landing in Appalachee Bay, Middle Florida, and made an incursion into the interior, coming out to the Gulf of Mexico, at Pensacola Bay, West Florida, of which they were the discoverers; but they left no permanent settlement. In 1538, De Soto effected a landing at Spiritu Santo, now Tampa Bay; and wandered into the interior as far as the Mississippi, of which he was the discoverer. Passing far west of that river, he returned to be buried beneath its waters; and left no permanent settlement in the country. In 1540, Pensacola Bay was again visited by the Spaniards, from Cuba; after which, for a long period, West Florida was neglected. Meanwhile, however, Spanish settlements, in the character of Roman Catholic, Missionary stations, were extended from Mexico, through Texas, to Red River; of which Nacogdoches and Natchitoches were the most important.

In 1689, attention was again turned to Pensacola Bay, and a Fort, called the Barrancas, was built near its mouth. This was followed, in 1693, by a settlement, where the town of Pensacola now stands. Thus Spanish immigration into West Florida was begun, and continued until 1763, when the whole of Florida was ceded to Great Britain; an event which was followed by the emigration, to Cuba and Louisiana, of a large portion of the inhabitants. After the lapse of twenty years, it was restored to Spain; when these people returned in considerable numbers; but, on the sale of Florida to the United States, in 1822, the greater part of them left it.

The Spanish immigration to the banks of the Mississippi, and its tributaries, began with the transfer of Louisiana to Spain, in 1769, as already mentioned. The new-comers extended their settlements up the great river to the Missouri; but on the retrocession of the country to France, in 1802, and its sale to the United States, in 1803, most of the Spanish population again emigrated to Florida, Cuba, and Mexico. Thus the Spanish Creoles, at last, make but a feeble element of our population. In modes of living and physiology, they resemble the French, much more than they do the Anglo-Americans; and have intermarried with the former more extensively than with the latter. If we pass from West Florida and Louisiana, to the Valley of the Rio del Norte, we find a larger Spanish population extending up to Santa Fe and the Valley of Taos, and westwardly to the Sierra Madre.

IV. The British.—The next immigration into our Valley was British, and took place, both on its northern and southern borders. Immediately after the cession of Canada, in 1763, the English, Scotch, and Irish began to enter it by the St. Lawrence, and these streams of immigration have continued ever since; that from Ireland being, in the latter years, much greater than both the others. In Canada East, the immigrants from Great Britain and Ireland, with their descendants, make a large proportion of the whole population; and, in Canada West, there are few others, except immigrants from the United States. They have spread out, in detached trading establishments, to the north-west, as far as Lake Winnipeg and Hudson Bay; in fact, to the west of both, up to the Rocky Mountains. More enterprising and diversified in their pursuits than the Canadians — as the French are called — they are, at the same time, more addicted to a full diet and intemperate drinking.

The British emigration to West Florida, during the twenty years which England held that Province, was not very great. Yet Pensacola and Mobile were once English towns: and the first notice we have of the medical topography and fevers of those localities, is to be found in the well-known Essay on the Diseases of Hot Climates, by Dr. Lind, an English naval surgeon. After the restoration of Florida to Spain, in 1782, most of the British population withdrew.

Having thus traced out the only *direct* emigrations from Europe to our Valley, which preceded the *indirect*, or that of Europeans and their descendants from the Atlantic states, we are now brought to the latter which, as we shall see, make up the mass of its population.

V. Immigrants from the Atlantic States.—Before proceeding to speak of the peopling of our Valley, by emigrants from the Atlantic States, it is proper to give the dates of the settlements of those states, which, in the order of time, are as follows: Virginia, 1607 — New York, 1615 — New England, 1629 — Delaware, 1630 — Maryland, 1632 — Pennsylvania, 1643 — New Jersey, 1650 — North Carolina, 1660 — South Carolina, 1670 — Georgia, 1733.

The first advances of population to this side of the Appalachian Mountains, were from the colonies of North Carolina, Virginia, and Pennsylvania, into a region extending from the Tennessee River to Lake Erie. Permanent settlements were begun in East Tennessee, as early as 1761; in Western Virginia and Pennsylvania soon afterward. The settlement of Kentucky, then a part of Virginia, began in 1774; that of Ohio, by immigrants from Massachusetts, in 1788; that of Indiana and Illinois, about 1795; that of Mississippi and Alabama, at a still later period; that of Florida, in 1822; of the states beyond the Mississippi, in 1804; of Western New York, including the coasts of Lakes Erie and Ontario, about 1788; and that of Texas, by Americans, in 1822. Thus the oldest Europo-American settlements in the Valley, are those of Eastern and Middle Tennessee, North-west Virginia, South-west Pennsylvania, and Kentucky.

The majority of the people of Western New York are either from the eastern portions of that state, or from New England; those of Western Pennsylvania, from the middle portions of that state, embracing a large proportion of Irish, Scotch, and Germans; those of Western Virginia and Kentucky, from the eastern and middle regions of the former, and from Maryland; those of Tennessee, from North Carolina; those of Alabama and Florida, from South Carolina and Georgia; those of Mississippi, Louisiana, and Arkansas, from North Carolina, Virginia, Kentucky, and Tennessee; those of Texas, from all the states just named; those of Missouri, from North Carolina, Kentucky, Tennessee, and Virginia; those of Ohio, from New Jersey, Massachusetts, Connecticut, and other New England States, New York, Pennsylvania, Maryland, Virginia, and Kentucky; those of Indiana, from Ohio, Kentucky, and Pennsylvania; those of Illinois, from Ohio, Kentucky, and New York; those of Iowa, from Kentucky, Ohio, Indiana, and New England; those of Michigan and Wisconsin, from New York and New England.

These statements must be received in the most general sense; for, though various regions have a great predominance of people from some of the old states, still the intermingling in every part of the Valley has been very great. South of the Ohio River, both east and west of the Mississippi, the chief elements of this intermixture, are from the slaveholding, Atlantic States, south of Pennsylvania; while north of that river, they are derived from the non-slaveholding states, including the one just named. As we advance westwardly from the Alleghany Mountains, into the newer states of the Valley, the elements of variety display a regular increase; and thus the later the settlement of any portion of the Valley, the more is it compounded; which is especially true of the non-slaveholding states. It is scarcely necessary to add, that these immigrants, together with their descendants, constitute the greater part of our population, from the Lakes to the Gulf of Mexico. There are, however, many immigrants from Europe, who have reached us, and are still arriving, through the Atlantic states, and deserve a passing notice.

VI. Late and present immigrants from Europe.—For the last quarter of a century there has been a direct and increasing immigration of northern Europeans into the Valley; the majority of whom have settled north of the thirthy-ninth degree of latitude. Nearly all have come from kingdoms north-east of France, that is, above the fiftieth degree of latitude. In the order of their numbers we may begin with,

1. *The Germans.*—They are from various parts of Germany, and outnumber the immigrants from any other part of Europe. But few of them settle in the slave States, with the the exception of Missouri. They are most numerous between the Lakes and the Ohio River. While many remain in the larger towns and cities, the majority disperse into the country, where they amalgamate readily with the existing population.

2. *The Irish.*—In number they stand next to the German immigrants. More disposed to inhabit cities than the country, and less offended by slavery, they are found in large numbers in New Orleans and Mobile, not less

than in St. Louis, Louisville, Cincinnati, Pittsburgh, Buffalo, Montreal, and Quebec. In the two latter cities, and, generally, north of the Lakes, they are much more numerous than the Germans.

3. *The English.* They, no doubt, rank next in number, but scattering, and bearing a close resemblance to their brethren of the Valley, are soon confounded with them. In Canada and the lead-mine regions of Illinois and Wisconsin, they are numerous.

4. *The Scotch.* Less numerous, perhaps, than the English, and found both in town and country. They are chiefly from the Lowlands. More numerous in Canada than the United States.

5. *The Welsh.* More clannish than the last two, they have settled chiefly in Cincinnati, and in the south-eastern portions of Ohio; where many of them are employed in its iron mines and coaleries.

6. *The Norwegians.* These make a new stream of immigration. Its termination is in northern Illinois, Wisconsin, and Iowa, about the forty-third degree of latitude.

7. *The Poles.* The revolutions of Poland, have dispersed a considerable number of the people of that country over the Valley. They are chiefly men, and abide in towns and cities.

8. *The Jews.* Mostly English, German, and Polish; they prefer the cities, and are found from Quebec to New Orleans. They are, perhaps, more numerous in Cincinnati than in any other city.

VII. National Genealogies.— Such are the principal elements of our population. We have seen that a vast majority have been derived from the Atlantic States; and it remains to inquire, whence they or their ancestors originally emigrated to those States. The answer is, almost entirely from Great Britain and Ireland — above all, from England. Emigrants from the last, were almost the exclusive settlers of New England; contributed liberally to the settlement of New York and New Jersey; still more largely to that of Pennsylvania and Maryland, and composed nearly the whole population of Virginia, the Carolinas, and Georgia. But there were, among the early immigrants into the Atlantic colonies, several communities, which deserve to be mentioned. The most numerous were the Low Dutch, in New York and New Jersey; Swedes and Germans, in Pennsylvania; and French Huguenots, in South Carolina.

When we trace up these streams of European emigration to their sources — distant in point of time and space — we have the following results. *First.* The Irish, Welsh, Highland Scotch, Normans, Low Dutch, and French, land us among the Kimmerian or Celtic nations — the earliest known inhabitants of western Europe; and distinguished by different appellations in different countries, as the Kelts, Kimbri, Belgæ, Erse, Cimbri, Britons, Scots, Caledonians, and Gauls. *Second.* The English, Lowland Scotch, French, High Dutch, Swiss, Danes, Swedes, and Norwegians, carry us to the Scythian or Gothic nations; of which the Saxons, Germans, Angles, Jutes, and Franks, were the principal tribes.

Laborious researches have convinced the ethnogrophers, that both these classes of nomadic barbarians, entered Europe south of the Baltic, from beyond the Euxine or Black Sea; and were, in fact, wanderers from the Caucasian Mountains, and the plains of Asia lying north of them; but that the migration of the Celtic, was many centuries before that of the Gothic hordes.

Let us change from analysis to synthesis, and thus obtain a fuller view of the composition of our society. The amalgamation of tribes, by which the main stock of our population was formed, began in England. During the time that island was held by the Romans, the Celtic population must have received an infusion of Pelasgic, or southern European blood, not less than of civilization. Then came the conquests by the Saxons and Angles, and the establishment of the Anglo-Saxon nation — with which, however, the Celtic population must have become more or less blended — although many were destroyed, and many driven into the mountains of Wales. The conquest, and long occupation of the country by the Danes, contributed another, though kindred element; as they had descended from the Jutes, a Gothic race. Lastly, the Norman conquest introduced another element, which, from its magnitude, must have greatly changed the blood and national character of the conquered. Thus, we see that the compound term, Anglo-Saxon, is not an accurate expression for the present English race; but an arbitrary epithet for a compound of Celts, Romans, Angles, Saxons, Jutes or Danes, and Normans; in which the predominating elements are those which have imposed their names upon the mass. Emigrants from this mass, peopled the Atlantic States; where they absorbed a portion of Swedish, Low Dutch, French, German, and Irish blood; then ascended the Alleghany Mountains, spread — and are still spreading — over the great Valley, and constitute the basis and bulk of our population.

SECTION III.

PHYSIOLOGICAL CHARACTERISTICS.

The modifications of physiology, consequent on the immigration and intermingling of western Europeans in America, may be considered as prospective rather than present. Races do not change their type in a single generation, and some preserve it for long and indefinite periods; though placed under conditions which, *a priori*, might be expected to work out rapid changes. In comparing the circumstances which surround the people of the Interior Valley of North America, with these which surround their European brethren at home, we may refer them to several distinct heads; and, although not able to appreciate the exact influence of either, they must be regarded as causes, of which the effects will, in due time, be so far developed, as to merit the attention of the practical physician. The causes to which I refer, may be included under the following heads: *First.*—Intermarriage: *Second.*—Change of climate: *Third.*—Change of Food: *Fourth.*

—Change of political, moral, and social condition. Let us consider them separately.

I. INTERMARRIAGE.—As western Europe was peopled by nomadic and barbarous tribes, of a warlike spirit, civilization found them divided into many kingdoms; between which, until within the last thirty years, that is, since the downfall of Napoleon, there was but little intercourse, and, consequently, but little intermarriage.

The density of population, has even prevented much intestine change of place, by the people of the same kingdom; who, in its different counties or departments, have continued, through a long period of time, to intermarry with each other; and thus perpetuate their characteristics, corporeal and mental; which perpetuation has been negatively promoted, by the subsistence of each nation, for many generations, on the same kind of diet; in climates which continued without alteration from time; under the influence of forms of government that underwent no important modification, and with usages and manners which varied quite as little. In short, from the remote period, when the Celtic nations were conquered by the later Asiatic hordes, chiefly known under the names of Goths, Saxons, Germans, and Franks, down to the present century, all the circumstances favored the full development of well-defined varieties of constitution, in the different kingdoms of that continent.

The history of the settlement of our Valley, as sketched in the preceding section, shows how much its people differ from their brethren of the old world, and even of the old states of the Union, on the subject of intermarriage.

1. Our frontiers, from Quebec, round by the Lakes and Hudson Bay, to the Gulf of Mexico, beyond the Rio del Norte, present a mixed race of whites and Indians; which is gradually lost, in the population residing immediately *within* that boundary. Thus Indian blood is, as it were, absorbed by the surface of the new nation. The readiest amalgamation with the people of that race, is by the northern French, and the southern Spanish Creoles; but the Anglo-American immigrants from the Atlantic States, and their descendants have, at all times, when war did not prevent it, shown a propensity of the same kind.

2. Wherever there is a negro population, bond or free, the same coalescence is displayed; so that in all our towns, from Mobile to Montreal, and from Pittsburgh to St. Louis, the streets are more or less thronged with mulattoes, quadroons, and other mixed breeds; all pressing upward, that is, ambitious of intermarriage with those whiter than themselves; and thus our Caucasian blood is constantly, though slowly, acquiring an African element. In the willingness for this commingling, the Spanish Creoles of Florida, Louisiana, and Mexico stand first; next come the French Creoles of the Lower Mississippi; then some of the classes of the modern emigrants from Great Britain, Ireland, and Germany; lastly, the native Anglo-Americans.

3. In Canada, intermarriage between the French and British population, although limited by the prejudices of race, and the aversion of the conquered toward their conquerors, is by no means uncommon, especially in the

towns and cities, and hence the process of assimilation is going on; in the west, as along the middle portions of the Mississippi, marriages of the French with Anglo-Americans are so common, that the former element is fast disappearing. On the lower Mississippi and the northern coasts of the Gulf of Mexico, the same union has been occurring ever since the cession of Louisiana; and, as the ratio is on the increase, a copious infusion of Franco-American blood into the Anglo-American, will mark the final absorption of the French Creole race.

4. In the same region, we have long been receiving, directly, or indirectly through the French, a tincture of Spanish blood.

5. Intermarriages by the English and Irish immigrants with the indigenous population of the Valley, are familiar events; and if the language of the German immigrants oppose, for a while, the same kind of union, the work of amalgamation is only deferred. In other words, they are not destined to form distinct and permanent communities any where in our Valley, as they once did in Pennsylvania. It will, no doubt, turn out in the same way with the Norwegians, now pouring into the regions west of the great Lakes.

6. Finally, immigrants and their descendants, from all the Atlantic States, here intermarry, unrestrained by any kind of prejudice; for, on reaching the Valley, their sectional feelings are soon moderated, and many of their antipathies become extinct. Even in the extreme south, among the immigrants from the Carolinas and Georgia, the introduction of New England, New York, Pennsylvania, and Ohio blood, is constantly going on. A large proportion of the emigrants, of both sexes, from those states, are unmarried persons — young men who go out as overseers or superintendents of plantations, clerks, mechanics, watermen, merchants, teachers, physicians, lawyers, and divines; and young women who teach, or act as governesses. The marriages of these classes are not, in general, among themselves, but with the children of the resident population; and thus the north mingles with the south in the lower parts of the Valley; while in the upper, the immigration of families from Virginia, Tennessee, and Kentucky, brings out the same result.

From all this it follows, that the world has not before witnessed such a commingling of races. Those of England and the Atlantic States, the most complete of modern times, bear no comparison with ours; and if we ascend to the earliest historic period, no case of equal complexity is met with. The Roman Empire, it is true, was greatly compounded; it was, however, an assemblage of distinct nations, between which there was but little, in many cases no, social, nor even commercial intercourse. It was an aggregate; ours is a living compound, as yet in the forming stage. Three out of five varieties of the human species, with all the important races which belong to one — the Caucasian or overruling element — cannot fail in the end to give a new physiological and psychological development.

In their western migrations from the sources of the Tigris and Euphrates, to the banks of the Mississippi, and the shores of the Gulf and Lakes, tribes and nations have been governed by a law of increasing social amalgamation.

The head of the Mediterranean Sea presented greater diversity than the plains of Chaldea — Greece still greater — Rome went beyond her — the population of western Europe is still more compounded — that of our Atlantic States, diversified in a degree yet higher — that of our Valley beyond all. Thus the union and living coalescence of nations, have been in the direct ratio of time and distance, from the birth-place of the species. The course has been westward, bending to the north in Europe, but again, as we have seen, inclining to the south, to reach America. Dr. Robert M. Patterson, of the United States Mint, Philadelphia, has investigated its direction in the United States for fifty years. In 1790 the center of population was near Baltimore, Maryland; and in 1840 it was in Morgan county, Virginia, both in the same latitude. Thus it appears, that the curve of migration for the United States, still runs nearly from east to west.

But the influence of the latter element is not at an end. The GREAT CENTRAL VALLEY OF NORTH AMERICA is the *last* crucible into which living materials, in great and diversified streams, can be poured for amalgamation. The double range of mountains which separate it from the Pacific Ocean, leave too little space for an empire on the shores of that sea; and the detached communities which may there grow up, will be but derivatives from the homogeneous millions, with which time will people the great region between the Appalachian and Rocky Mountains, which is thus destined to present the last and greatest development of society.

II. CHANGE OF CLIMATE. — While we recognize intermarriage as the greatest agent in transforming the races of mankind, we should not overlook external influences, of which climate must be regarded as one. Nor must we reject it because some naturalists, in their attempts to explain too much by it, have assigned it an influence too limited. The immense predominance of a dark or black skin, eyes, and hair, in the inter-tropical regions of Africa and Asia, with the equally uniform prevalence of the two latter, in connection with a swarthy complexion in the south of Europe and the corresponding latitudes of Asia, while the middle and northern parts of the temperate zone present an equal predominance of fair complexions, and light hair and eyes, would seem to leave no doubt, as to a general influence of climate on those parts of the body; but to suppose its agency limited to these, would be a most unphilosophical restriction, for many other physiological modifications may escape our observation.

As we have already seen, the people of western Europe, in emigrating to North America, have generally made ten degrees of southern latitude. If the mean annual heat of this country, and that, on the same parallels, were equal, this would be, as an emigration from Philadelphia or Cincinnati to New Orleans; but, in fact, they live in an average yearly temperature, so much the same as that to which they had been used, that but little influence can be ascribed to this element. There is, however, a striking difference between the summer and winter temperatures of western Europe, and those of the Atlantic States and the great Valley of the Interior; the extremes of the American, being far greater than those of the European continent. Sudden and extreme variations of temperature are, moreover, far more common in this portion of the new, than in that part of the old, world. Lastly, we have a dryer climate, and a more electrical atmosphere.

To these climatic conditions we are bound to admit a modifying influence; which, if I mistake not, is perceptible in the loss of a ruddy complexion, in a diminution of the capillary and cellular tissues of the face, and a consequent reduction of the convexity of the cheeks, with an increasing tendency to darker hair; in short, the production or further development of a bilious temperament. Without insisting on the accuracy of these special observations, I am convinced that whatever tendency exists, is not in the direction of the sanguine temperament.

III. Change of Food. — As a general fact, the inhabitants of America, and especially those of the Interior Valley, live on a fuller diet, than the masses of Europe. Their food differs in two respects: *first*, it is here, far more complex; *second*, the animal portion is much greater. The wheat of England, the oats of Scotland, the potatoes of Ireland, and the rye of Germany, are, in this country, represented by wheat, maize, rye, and buckwheat; and our hot summers permit the cultivation of a great number of culinary vegetables, and some fruits, which those countries cannot produce. The abundance and comparative cheapness of animal food — beef, mutton, and pork — in the great Valley, originates, however, the greatest dietetic distinction between the two countries. Of the natural desire for animal food, no observing man can entertain a doubt. It is among the earliest preferences of infancy; and the immigrants from Europe, who might have seldom tasted it, begin to indemnify themselves for their past privation, as soon as they arrive among us. Whether slow or fast to adopt other customs, they never fail to come into this; and like the indigenous inhabitants of the Valley, very generally eat it three times a day. This inordinate indulgence is often injurious, on their first arrival. Thus, Professor Brainerd, of Chicago, has informed me, that the Norwegian immigrants, on landing at that city, often sicken under the combined influence of meat and whisky. As the time is indefinitely remote, when the density of our population will limit the supply of animal food, it will long continue to enter inordinately into our diet; and, mingled with a great variety of vegetables, unskillfully cooked, indiscriminately mixed, imperfectly masticated, and rapidly swallowed, will constitute our national feeding. That such fullness and crudeness of diet, through successive generations, must work out peculiarities of constitution, and tendencies to some forms of disease, while it gives protection from others, can scarcely be doubted; but these things have not yet been made subjects of accurate observation.

IV. Change of Political, Moral, and Social Condition — In barbarous states of society, the influence of the mind over the body, is very small. In civilized communities, it becomes great, and bears a proportion to the degree of refinement. As our immigrant ancestors, not less than the people arriving from Europe, were civilized; and as the arts, if not the science and moral sentiments, which should animate and dignify civilization, are increasing among us; we must not overlook the modifying influence of moral causes on our national physiology. If these were the same, in the old and the new world, no change of constitution would result from a change of continent; but they are not.

1. Transplanted from the depths of a compact population, to one of great comparative sparseness, the immigrant has experienced a change, not unlike that of the individual who escapes from a crowd, to associate with a small and open company. His feelings, of both mind and body, undergo a modification by the change.

2. He passes from the midst of ancient works of art, to a new country, where natural objects, scenery, and events replace the artificial.

3. Instead of being compressed on every side, and limited to a small spot, beyond which he seldom passed, he finds ample space for locomotion, and, under the influence of slight motives, makes long journeys or frequent removals; thus, seeing many new objects, and forming new associations.

4. Leaving a state of society which doomed him to one and the same pursuit through life, he finds himself where freedom and facility of change are promoted, and extensively practiced; where new plans of business and exciting enterprises call him out, and inspire him to adventurous and novel efforts; in which he engages with a fearlessness proportionate to the facility with which, in this country, failures, which in an old state of society would be ruinous, may be repaired.

5. While in his native country, his thoughts, in reference to property, might never have risen above his daily bread; but he here sees many ways to wealth laid open before him, and has the love of property, with the comforts, luxuries, and influence, of which wealth is the instrument, awakened or quickened in his heart.

6. When in his native land, he saw, perhaps, but a single aspect of Christianity — one form of public worship, and one variety of worshipers; but he here finds himself surrounded by many. Freedom from legislative restrictions, permits an unrestrained manifestation of his opinions and feelings; he speedily sympathizes in some form of religious worship, and finds himself under the influence of more lively religious feelings; or drawn into the controversies which inevitably arise, in proportion as the superincumbent weight of an ecclesiastical *establishment* is thrown off.

7. But above all, in relation to the young, and to men, the immigrant from Europe is born into a political existence, in becoming naturalized in America. There he was governed, here he assists in governing; there, in feeling, he stood in opposition to the government, here, in practice, he seeks either to modify or preserve its administration. In ordinary circumstances, he was passive and obedient, he is now active and aggressive; he connects himself with a party, harkens to its tocsin, rallies to its standard, listens to expositions of its doctrines and objects, yields up his heart to its exhortations, and bends his will to its dictation; the servant becomes a civil officer — the peasant, a party politician. The variety and amount of emotion, the excitement of passion, and the activity of thought, developed by this new condition, are

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great in proportion to his previous torpor — as vegetation advances more luxuriantly after a cold than after an open winter. This is the true reason why our immigrant population are so eager to plunge into the party strifes which are forever heaving the bosom of our society.

Such are some of the new, social circumstances, under which the transplanted population of western Europe, live in our great Valley; and the physiologist cannot doubt, that the mental states, intellectual and emotional, generated and permanently sustained by them, will, in successive generations, work out changes of innervation; and coöperate with the physical causes which have been discussed, in creating a type of constitution different from that of Europe, or any that has gone before it in any country.

SECTION IV.

STATISTICAL PHYSIOLOGY.

For this portion of the physiological history of the Valley, our stock of materials is very small. They cannot be collected to any great extent, in the ordinary practice of medicine, and no societies, or even individuals, have as yet instituted the requisite courses of observation and experiment. I will give a few facts, under several different heads, in the hope of prompting those who have time and opportunity, to more extended inquiry.

I. Stature and Weight. — When upon the Northern Lakes, in 1842, I was enabled, through the accommodating politeness of the late Major Martin Scott, of Fort Mackinac, Captains Lynde and Thompson, of Fort Gratiot, and Captain Drain, of Detroit Barracks, to ascertain the stature of three hundred and sixteen soldiers of the United States Army, which I have condensed into the following

TABLE.

NO.	NATION.	MEAN HIGHT.			MEAN WT.		TALLEST.			HEAVIEST.
		Ft.	In.	Lns.	Lbs.	Oz.	Ft.	In.	Lns.	Lbs.
155	American,	5	7	7	148	9	6	1	6	189
82	Irish,	5	8	4	144	11	6		6	192
17	English,	5	8	4	147	2	6	2		183
10	Scotch,	5	8	2	146	8	5	10	9	167
45	Germans,	5	6		146	1	5	10	6	176
7	Danes and Poles,	5	6	5	143	7	5	10		165
316	The whole,	5	7	8	146	13	6	2		192
155	Americans,	5	7	7	148	9	6	1	6	189
109	Islanders,	5	8	4	145	3	6	2		192
52	Continentals,	5	6	4	145	12	5	10	6	176

The numbers in this table are too small to justify any general conclusions; and it should be recollected, moreover, in reference to weight, that most of these persons were not yet of middle age.*

As these soldiers had reached their full stature, their hight represents that of the nations to which they belong, so far as their number goes; but as most of them were between twenty and thirty years of age, they had not yet reached their full weight; and can only serve as representatives of their respective nations in early manhood. Nevertheless, as the different groups were composed of persons in the same periods of life, they may be compared with each other. In bringing each class to the standards or mean terms of the whole, we find, in reference to stature, that the Americans are at, or rather, within one line below it; the English, Scotch, and Irish rise above it; and the Germans and other continentals fall below it. In reference to the standard of weight, the Americans are above, the rest below it.

The following statement of the relation between stature and weight, shows how much of the latter is due to an inch of the former:

TABLE.

The whole, - - -	one inch gives - - -	34.60	oz. avd.
Americans, - - -	" " " - - -	35.17	"
English, - - - -	" " " - - -	34.45	"
Irish, - - - - -	" " " - - -	33.88	"
Germans, - - -	" " " - - -	35.41	"
Scotch, - - - -	" " " - - -	34.38	"

From this table it appears, that the English and Scotch approach within a few decimals of the standard of the three hundred and sixteen individuals of the preceding table, in the weight which belongs to an inch of their stature; the Irish fall seventy-two hundredths of an ounce, or two *per cent.* below it; while, on the other hand, the Americans rise fifty-seven hundredths, or one-sixth *per cent.*, and the Germans eighty-one hundredths, or two-thirds *per cent.* above it. Thus the Germans are the heaviest of the whole, in proportion to their hight, and next to them stand the Americans. This difference argues, either greater development of flesh, or a longer trunk of body compared with the lower extremities. The ratio between the stature and weight of different races, in the corresponding periods of life, being ascertained, the weight of any considerable number of individuals of that race, might be inferred from a knowledge of their stature, *et vice versa.*

In the absence of more conclusive statistics, I may say, that English, Scotch, and Irish immigrants, are so near the stature of the native inhabi-

* If any one make such inquiries, he should be aware, that he should not combine his averages with those of the table, and take the mean term of the two sums, unless the number of individuals were the same as in the table; for the result would be erroneous. He must multiply the number of individuals, composing the class in the table which he wishes to enlarge, by the mean hight or weight, and to the product add the aggregate hight or weight of those he has examined; when, on dividing the whole amount by the whole number of men, he will obtain the desired result.

tants of the Valley, as, in that particular, to be identified with them; that the Germans, the Jews, and the French, both of Louisiana and Canada, are regarded as smaller. The Norwegians, whom I saw in Illinois and Wisconsin, appeared to be taller than the Germans. It is a current opinion that, of the natives of the Valley descended from British and Irish ancestors, the largest men are those of western Virginia, and the eastern and middle portions of Kentucky and Tennessee; where they breathe a salubrious air, abound in sustenance, and take exercise enough to preserve health; but do not perform sufficient labor to carry out of the system, by copious perspiration and increased pulmonary exhalation, a great amount of solid matter.

In our towns and cities, many young men, who grow up without much exercise or labor, and spend their time chiefly within doors, fail to reach the standard size; but those who follow laborious, mechanical, or miscellaneous employments, have a larger development of the system, and, consequently, greater bulk. On the whole, however, the people of the country attain a greater size than those of our cities.

Family and individual eccentricities of size are, of course, not uncommon among a people so diversified in origin, and advanced in civilization — a state which develops greater anatomical and physiological varieties, than the state of barbarism. In different parts of the Valley, families of remarkable stature are met with; and occasionally, a single member of a family rises above the rest, and overreaches the tallest around him.

II. Strength. — No experiments on the strength of the native or immigrant races of the Valley, have yet been published. It is a current opinion, that as we advance south, from the middle latitudes, it diminishes; in other words, is inversely to the mean temperature. Comparing all the inhabitants of one of our towns or cities, with an equal number in the surrounding country, the aggregate strength of the latter, would, I have no doubt, be found much greater, except in malarial districts. In a country long and thickly settled, where the labors of the people consist largely in stirring the loose soil with the plow and hoe, in pruning hedges and orchards, training vines, gathering in crops, and in the care of domestic animals, this might not be the case; but in a new country, where overshadowing forests are to be subdued, shrubs and bushes grubbed up, fields inclosed with heavy rails mauled out of the trunks of trees, log houses erected, stone quarried, roads opened, bridges built, and canals excavated, the labors are, in kind and degree, well-fitted to develop large, compact, and powerful muscular systems. Such from the beginning of immigration, have been the labors of a majority of our people. In the older settled regions, they are less than formerly, but in all the new States, they still continue.

But in latter years, a great number of men have been called to new labors, requiring, and therefore, developing, great muscular power. I may briefly enumerate some of these: The erection of cities, such as Toronto, Buffalo, Chicago, Pittsburgh, Cincinnati, Louisville, St. Louis, and New Orleans; the preparation and embarkation of the agricultural staples—flour, corn, pork, beef, hemp, tobacco, and cotton—the lumber trade of Canada, of the mountains of New York, and of the cypress swamps of Louisiana; the preparation of fuel for our five or six hundred steamboats between New Orleans and Quebec, and the labors upon those vessels of firemen and deckhands; lastly, the incessant use of the oar or paddle, and the carrying of heavy burdens by trappers and *voyageurs* on the rivers of the north-west.

Many other classes might be named; but these will serve to show that our country abounds in employments, which cannot be prosecuted without developing great muscular strength.

CHAPTER II.

MODES OF LIVING.

Several things which properly belong to this head, have already been mentioned, when treating of the causes which work out changes of constitution in European emigrants, or develop size and strength in our native population. We now recur to them, and, including many more, consider them in reference to the production of disease. Modifications were all that we have studied; that which remains for this chapter, is more obviously etiological.

SECTION I.

DIET.—SOLID FOOD.

I. The custom of the laboring classes, of both town and country, throughout the Valley, is to eat three meals a day; the first not far from, but generally after sun-rise; the second at or soon after noon; the third at or not long after sun-down. Taking the year throughout, this would give an average of six hours between breakfast and dinner, and the same period between dinner and supper. Now it appears from experiments,* which the feelings of individuals verify, that about five hours are necessary to the digestion of a meal of an ordinary kind, the person being in good health; and the established opinion of the profession is, that the stomach should remain empty and at rest, for an hour, more or less, after it has decomposed and discharged its contents. The customary hours of the people would seem to be correct. But this is still further evinced by a reference to the time for

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* Dr. Beaumont.

sleep. This, to speak as a physiologist, is the night, and the signal for rising is the return of day. Now, when the stomach has been empty for some hours, it demands the stimulus of food, and many persons feel great inconvenience, after rising in the morning, till they take it. Hence it results, that early breakfasts are physiological and salutary, because early rising is according to the natural laws of our constitution. But these habits, although consonant with our physiology, are often violated. Many persons rise and breakfast late, dine late, and make a slight meal in the evening. Others do not dine until near the supper hour of the people, but lunch about their dinner hour, making three meals a day, coming back toward the natural times, but making the evening meal the principal one. Others again dine at two or three o'clock, sup lightly, and make a heartier meal at nine or ten. Thousands may be found who enjoy good health under these diversities of time; but they are all departures from the plan of nature, and thousands might be found who suffer from them. The late supper has been condemned as unhealthy and even dangerous, as to certain constitutions it certainly is. But if the individual sit up till the last meal is digested, he will sleep more quietly to take a slight repast of digestible food, avoiding all diuretic drinks, for diaphoresis should prevail over all other secretions during sleep.

Among the laboring classes, who follow nature more closely than the others, the three meals of the day do not differ so much in quantity, as among the more cultivated and artificial classes. I am persuaded that the former are right; and would go still further, and express the opinion that, of the three meals, breakfast, and not dinner, should be the principal. After long repose, in the cool of the morning, when the feelings of both body and mind are tranquil, the stomach can receive with impunity, and digest a large meal better, than in the heat of the day; or in the midst of the labors and corporeal and moral irritations which it may bring forth. A hearty breakfast seldom produces oppression and drowsiness, like a hearty dinner; on the contrary, the hour which follows it is generally one of pleasant and efficient excitement; while that which succeeds to a full dinner is characterized by dullness, taciturnity, sleep, and very often a considerable degree of feverishness, from all of which, I may repeat, those who make hearty breakfasts and slighter dinners, are exempt.

The practice of rapid eating is universal among us, that is, prevails everywhere, though not adopted by every individual. Two objections lie against it: *first*, the food is imperfectly masticated; *second*, too much is taken; for a little time is necessary after food is received into the stomach, to enable it to remove the feeling of hunger.

As a general fact, the people of the Valley eat too much. Such an excess is the natural effect of living in a country whose greatest natural characteristic is productiveness of sustenance; and until the abundance of the latter, in proportion to the population, shall diminish, the practice will continue.

II. We come now to the composition of our diet; and the first observation I make is, that the quantity of animal food consumed in the Valley is very great, compared with the vegetable. Indeed, it may be affirmed that more is eaten than by any equal number of people in the whole world. With a limited number of exceptions, meat is on the table three times a day, and as often eaten by the great majority. Even children, in most families, are allowed to eat it at every meal. Our meats present quite a variety, but the flesh of the ox and hog greatly predominate; the former eaten from the shambles much more than from the tub — the latter converted into pickled pork, bacon, and sausages. Veal, on the whole, seems to be a greater favorite than mutton, which is no where in the Valley consumed in large quantities. Poultry is consumed in liberal quantities, and wild gallinaceous birds and waterfowl are eaten to a considerable extent. Eggs are used in great numbers. It is only on the shores of the Lakes and the Gulf, that fish make an important article of diet. In the country, bacon and pork predominate— in the larger towns and cities, fresh beef, and other fresh meats, are more extensively used. Butter, often of an inferior quality, is used in liberal quantities, and the taste of our population is, to eat buttered bread with their meat.

Thus, whatever modification of physiology, or predisposition to disease, may be producible by excess of animal food, is experienced by the people of the Valley; but I am not prepared to delineate them. The practice of abstaining from animal food, recommended on purely theoretical grounds, and at war with the configuration, instincts, and experience of our race, has made but little progresss in the Valley, and is not likely to find many advocates. If the effort should diminish the quantity consumed by each individual, it will be a public benefit; but if it should only reduce the aggregate by the total abstinence of a few, no good will result to them or the community at large. A liberal consumption is not confined to the cool weather and healthy seasons of the year, but prevails in summer and autumn, not less than at times to which it would seem to be better adapted.

Wheat flour and Indian corn-meal, variously prepared, constitute our "bread-stuffs." Fermented wheat bread is far from being universal, and hot, unleavened biscuit, with fat, is a favorite article on the breakfast and supper table, especially in the southern half of the Valley. They are eaten with butter, which is always melted by their heat, and thus prepared, become an accompaniment of animal food. It is undoubtedly true, that this national compound embarrasses the stomach of the dyspeptic; but the general aspect of the majority of the people would seem to indicate that they find it digestible and nutritious. In the cities, fermented rolls, without fat, but eaten hot, very commonly replace the unleavened biscuit of the country and smaller towns. The fashion in the Valley is to use the finest bolted flour, but bread made from that which contains a portion of the fine bran, is superior in everything but whiteness — a quality of no real value.

The pulp of Indian corn-meal, but slightly susceptible of fermentation, is generally baked in small rolls or cakes, and eaten hot. Nearly destitute of gluten, it is more pulverulent than hot wheat bread, and does not, by mastication, become compact and clammy. It is more aperient than the latter, but persons unaccustomed to it, are apt to experience acidity of the stomach from its use. Of its nourishing qualities there can be no doubt, as it enters extensively into the diet of large portions of our population, especially those which attain the greatest development.

Rye, barley, potatoes, rice, and pulse, are seldom employed in the fabrication of bread. Buckwheat is in more general use, and always prepared in the same manner — that is, in fermented pancakes, eaten with abundance of butter.

Culinary vegetables are abundant in all parts of the Valley, except in certain tracts bordering on the Gulf of Mexico, which are too sterile to produce them in any but limited quantities. Different varieties of pulse are abundant everywhere. The same is true of cabbage, but the finer varieties are not extensively cultivated. The turnip is generally disseminated. The sweet potato (*convolvulus battata*) comes to great perfection in the southern zone of the Valley, whence it is exported to the north. But the common potato (*solanum tuberosum*) is scarcely worth cultivating in the south, which is supplied from the middle parts of the Valley, and from the north, where its quality and quantity are excellent. The tomato (*solanum tomato*) is of recent introduction, and has become a universal favorite, being cultivated and consumed from the Gulf to the Lakes.

A great deal of fruit is consumed. In the direction of the Gulf, oranges, chiefly imported, are abundant, and figs and peaches are cultivated and abound. The apple, however, has not been much cultivated south of the thirty-third degree of latitude, from which to the Lakes, it is abundant, of great variety, and of excellent quality; furnishing large supplies for home consumption, and for exportation to the States resting on the Gulf. The peach, cherry, and pear, come to good perfection in the middle latitudes, and the two latter, with plums in abundance, are found high in the north, forming considerable articles of consumption. The strawberry is widely disseminated, and bears luxuriantly. Various kinds of grapes are grown in abundance, south of the fortieth degree of latitude.

It would be tedious to extend this enumeration of our indigenous sources of vegetable food. All that I have enumerated are consumed in large quantities, and show that while we use a great deal of animal food, we also eat a great deal of vegetable; in other words, that our diet is liberal, diversified, and nutritious. It differs, therefore from the diet of some nations which is deficient, or innutritious, or consists of one or a few articles repeated through the year. It would require a very careful comparison to determine the physiological effects of these national differences. I shall only say, that I suppose a mixed diet, varying at different times, to be most favorable to the full corporeal and intellectual development of man; and that repletion produces fewer diseases than inanition.

The culinary arts are but little understood by a great majority of the people of the Valley; who find in quantity and variety, a substitute for qualities which depend on skillful cookery. I cannot attempt to enumerate all the vicious modes of cooking that may be supposed to exert an influence on health, but will glance at a few.

1. With the mass of our population, bread of every kind is apt to be baked too soon after the flour or meal has been wetted—that is, before there has been sufficient maceration. But what is still worse, it is scarcely ever baked enough.

2. Biscuits, as they are called, are baked in close ovens, by which process the fat they contain is rendered empyreumatic and indigestible.

3. When the dough for leavened bread, by excess of panary fermentation, has been charged with acetic acid, that product is not in general neutralized by the carbonate of potash or soda, but the bread is eaten sour.

4. Pastry, instead of being flaky and tender, is often tough and hard, sometimes almost horny.

5. Meats are often baked and fried, instead of being roasted or broiled, whereby they become impregnated with empyreumatic oil, and not unfrequently charred on the outside. In general, they are overcooked.

6. Fresh meats, and especially poultry, are commonly cooked too soon after death.

7. Soup is often prepared from parts deficient in gelatine, and abounding in fat, which swims upon the surface, and is much more indigestible than the meat would have been, if eaten in the solid form.

8. Eggs are generally boiled so hard as to render them tough, and many are eaten fried in fat, to a still greater degree of induration. Fried bacon and eggs, eaten with hot unleavened biscuit, containing lard, and then buttered, is a favorite breakfast in many parts of the Valley.

9. Vegetables, abounding in fecula, such as potatoes, rice, and pulse, are often boiled so little, that all the starch grains are not burst open; while those containing albumen, as cabbage, are boiled until that element is firmly coagulated and deposited in the structure of the leaf.

SECTION II.

LIQUID DIET, AND TABLE DRINKS.

I. MILK is abundant, in the northern and middle zones of the Valley; scarcer and poorer in quality, in the southern. That of the cow only is in use. I know of no experiments to determine the difference in the composition of the milk of the south and the north. The butter and cheese of the former are chiefly imported from the latter, or from other parts of the United States. In the southern zone, milk is not a standing article o food; but, in the middle and northern, great quantities are consumed, especially in the country. In no part of the Valley is milk used more profusely than in Kentucky and Tennessee, where it enters more largely into the diet of men, than of women — the latter consuming more tea.

Now, it is in these states that the calculous diathesis, among males, prevails to a greater extent than in any other portions of the Valley. In the southern zone, where milk, from its deficiency and inferiority, is but little used, calculous disorders are rare. In the northern zone, where the manufacture of butter and cheese for exportation are objects of rural economy, it is less used. Is it not possible that, in the states just mentioned, the phosphate of lime, contained in the milk, contributes to produce the phosphatic diathesis? The curd formed in the stomachs of dyspeptics, from excess of acid, is often oppressive to them.

Butter-milk is decidedly nutritious; and, after having been kept, in warm weather, until it becomes slightly sour, from the development of lactic acid, is a cooling and salubrious drink, which is freely used in some portions of the country; but not, on the whole, to the extent, referring to summer health, that it merits.

II. Ice Cream.—The consumption of ice cream has been increasing in the Valley, for the last quarter of a century; previously to which its use was quite limited. At present, it is used, in summer, in all our cities, from the Lakes to the Gulf of Mexico; and makes an important part of the luxuries provided by the wealthier classes, for their evening parties, throughout the year. For a long time, many persons regarded it as dangerous in hot, and absurd in cold weather; but these prejudices are now nearly extinct. I have not had occasion to observe any injurious effects from it, that might not be traced to two heads: *first*, swallowing it before the ice has dissolved in the mouth, when it sometimes raises an acute pain in the pharynx, and gives a sense of coldness and sinking in the stomach; *second*, eating it when the stomach is torpid and inactive from dyspepsia, and the individual is inclined, at the time, to sick headache. The composition, not less than the coldness, contributes to the injury in this case. Under all other circumstances, ice cream may be regarded as equally salubrious and pleasant. When its coldness produces bad effects, they are best corrected by a diffusible stimulant, such as ammonia, wine, ardent spirit, or a cup of hot tea or coffee.

III. Lemonade is chiefly drunk in our cities, and on steamboats. Th cooling properties of all the vegetable acids, is an established fact; and there can be no doubt that in summer this is a salubrious drink. It is, however, generally made too rich, that is, into a pleasantly acid sirup; when it exerts but little influence in quenching thirst. Those who, in hot weather, are inclined to fever, or oppression of the brain, derive great benefit from this beverage, when properly prepared. It is only those who labor under non-inflammatory dyspepsia, with liability to attacks of sick headache, that are injured by it. The fresh lemon, affording citric acid, should always be used in the preparation of lemonade, as the lemon sirup, so called, is generally acidulated with sulphuric acid.

IV. Tea is used in every part of the Valley, but more generally in the north than the south. Green tea is preferred to black, though there is an increasing use of the latter. It is commonly drunk with milk and sugar.

Many of the country people use tea in the morning as well as the evening; others in the latter only. In the cities and larger towns, it is confined, by the majority, to the evening, or third meal. All the world knows, that the various kinds of green tea are stimulating, but do not produce either intoxcation, fever, or inflammation; that their influence is especially felt in the animal functions, and by the skin and kidneys, according, in reference to the two latter, to the season of the year — being sudorific in hot, and diuretic in cold weather. The exciting effects of black tea are much less; and it is, therefore, at once, less injurious to health and less used. It is common to say, that tea, apart from the milk and sugar mingled with it, affords no nourishment; but the analysis of Mulder * shows that it is not destitute of nutritive principles, as it contains gum and albumen, in addition to the peculiar principle *thein.* Of all known stimuli, I regard tea as the most genial, in reference to the intellectual functions and the moral feelings. Its injurious effects come from two causes: *first*, the excess of hot water with which it is prepared, diluting too much the solid contents of the stomach; *second*, drinking it too strong. In the Valley, these abuses, especially the latter, are far from being uncommon, especially among females. Thus abused, tea produces or increases dyspepsia, acidity, sick headache, morbid sensibility, hysterical affections, and muscular tremors. A distinguished pioneer of the banks of the Ohio, was accustomed, night and morning, through life, to drink from eight to twelve cups of green tea. He attained to old age, with an unimpaired intellect; but for many years was affected with tremors of the muscles, especially of the arms. His death was from cancer of the lip. Did the application of so much hot beverage to his mouth, have any effect in awakening that disease?

Children and young persons should drink their tea weak. The aged are often kept from sleeping, by tea of no greater strength than what they had been accustomed to drink for many years before. The middle part of life is that in which the injurious effects of strong tea are least perceptible.

To obtain the exciting properties of tea, it is necessary to prepare it in close vessels, with boiling water, and to drink it soon after the water is poured on. It is not generally understood, that the stimulating quality resides chiefly in a volatile oil, and not in the astringent matter which by long "drawing" is given out.

V. Coffee — of which that from Rio Janeiro is in most common use — has been gradually banishing tea from our breakfast tables, and is now in general use at that meal; in many families, at supper also. With many of the country people, however, who are scarcely ever without tea, coffee is regarded rather as an occasional luxury. By them, and, indeed, the majority of our people, the preparation of coffee is not well understood. It is often badly toasted, kept too long after that process, not properly clarified, too much boiled, and then, very commonly weakened with cold, instead of boiled milk or cream. The Creole French, from New Orleans to

* Pareira on Food and Diet.

Quebec, use coffee to the exclusion of tea; and the poorest among them understand how to prepare it. This knowledge appears to be, with some of them, a test of civilization. Thus, an English traveler,* who spoke the French language, in passing through the State of Indiana, called on some old Creole families, at Vincennes, settled by the French from Canada, in 1735, and, in the course of his visit, was offered coffee by an old lady, who, in speaking of the Americans, said, "*ils sont si bêtes ils ne savaient pas faire le café.*" Many of the French drink coffee on rising in the morning, and, also, after dinner; and the latter is done by a few Americans.

The composition of coffee, before being toasted, has a resemblance to that of tea, which never could have been suspected, seeing that one is a seed, and the other a leaf, from plants generically different. Caffein, the peculiar principle, is identical with thein. Coffee is, perhaps, more nutritious, and certainly more permanent in its stimulating effects, than tea. But its influences, on the whole, are less genial. Taken in large quantities, at once, it not only produces morbid vigilance, but affects the brain, so as to occasion vertigo, and a sort of altered consciousness, or confusion of ideas, not amounting to delirium; which I can compare to nothing so well as the feeling when one is lost amid familiar objects, which look strange, and seem to have their positions, in reference to the points of the compass, changed. I have experienced these feelings myself, after a cup of *café à la Français*, early in the morning, in New Orleans; and the late Professor Brown, of Transylvania University, informed me that, when traveling in North Alabama, he was thrown into the same condition, which lasted for nearly half a day, by drinking a large quantity of strong coffee, on an empty stomach, in the morning. He afterward died of apoplexy. There cannot be a doubt that such coffee produces, on the brain and nervous system, a more deleterious effect than strong tea. Like that beverage, it excites the mental powers and moral feelings. Palpitations of the heart, dyspepsia, pain and tightness about the head, muscular tremors, and various morbid sensibilities, follow its habitual abuse; and continue until it is laid aside, or proves fatal. Its diaphoretic and diuretic effects are less than those of tea. The disorders produced by tea are more common in women than men, who use less of it; but those from coffee are found equally among the two sexes; the greater susceptibility of the female constitution compensating for a more limited use of the beverage.

There is much reason for believing, that an early cup of coffee, in summer and autumn, is protective against the fevers of the southern part of the Valley. Certain it is, that the French population are less liable to them than the Anglo-American; but as they occupy the oldest-settled portions of the country, which, *cæteris paribus*, are least affected, allowance must be made for that. In various parts of the Valley, coffee is beginning to supersede ardent spirits, as a means of support and protection under fatigue

* Featherstonhaugh's Excursion.

and great exposure to the elements; for which purpose, all who have made the experiment, regard it as preferable.

VI. CHOCOLATE is but little used in the Valley, since the departure of its Spanish population from the Gulf coast. It is justly regarded as more nutritious, and less stimulating, than tea or coffee. The discovery in the kernels of the cocoa of a peculiar principle, *theobromin*, nearly identical in composition with thein and caffein, is certainly a curious fact, and seems to suggest a reason why these three articles, above all others, have become general among mankind, as nutritious and pleasant table beverages. The chocolate consumed in the Valley generally, is very much adulterated, and of an inferior quality. Its use is too occasional and limited, to have brought forth results of any kind, on the health or constitutions of individuals. In general it is complained of as promoting drowsiness. Its taste, even with every adulteration, is acceptable, and, therefore, it is generally classed with our luxuries.

SECTION III.

WATER.

I. THIRST, or the desire for water, must not be confounded with the desire for stimulants. Its final cause is the due preservation of the volume and fluidity of the blood; and the supply of a solvent and a vehicle, for matters which must be conveyed out of the system. The taste and effect of different kinds of water, depend on their temperature, and the matters which may be dissolved or suspended in them. The Valley of the Mississippi presents, in regard to both these sources of variety, nearly all diversities that are to be found in all other countries. In a preceding chapter we have set them forth, and it now only remains to consider them in connection with the preservation of health, and the production of disease. The first question is, what are the bad effects of water, resulting from its temperature? I am not aware that, except in summer, cold water produces any injurious effects. In the northern and middle zones, where the drinking water from springs and wells varies, in temperature, from forty-five degrees to sixty degrees, Fahrenheit, persons when heated are, at midsummer, sometimes injured, and even killed on the spot, by large draughts of water. This chiefly happens at deep wells, when great quantities are suddenly drunk without any stimulating admixture. In the southern zone, where the temperature of the springs varies from sixty degrees to seventy degrees, this unfavorable effect is seldom experienced. The majority of the people of that zone, especially those who reside in the country, drink water of the temperature just mentioned; but, in New Orleans, Mobile, and the smaller towns near the Gulf coast, ice has become a regular import from New England; and, throughout the summer, is made a constant addition to the water drunk by multitudes at home, and in all the hotels, and dram shops. By this addition the water, which individuals drink in hot weather, is often cooled down to fifty degrees, a temperature which frequently proves fatal in the higher latitudes. Still, I could not learn that injury or death, from these cold draughts, is of frequent occurrence in the towns of the Gulf. Indeed, Dr. Fearn assured me that, in Mobile, the introduction of ice had not been followed by that effect. If this be a fact, it seems to admit of but one explanation, which is, that where these cold waters are kept and drunk in houses, either private or public, they are commonly taken with ardent spirit or wine, the stimulus of which corrects the effects of a low temperature; while, in the towns so far north as to afford cold pump water, it is drunk by laborers in the street, unmingled with a stimulant, and, therefore, sometimes proves fatal.

I proceed now to notice the different kinds of water drunk and used for domestic purposes, in the various parts of the Valley, beginning with that of rivers.

II. River Water.—In most of the larger towns and cities, as Pittsburgh, Detroit, Cincinnati, St. Louis, and New Orleans, the people drink river water. It stands in reservoirs, exposed to the air and sun, until it has deposited a part of the earthy matters suspended in it; but, in floods, when the quantity is great, it is sometimes distributed and drunk while it is yet turbid. Besides the matters thus suspended, but heavy enough to be deposited, there are traces of muriate of soda, and carbonate and sulphate of lime, in solution; and, from the vast amount of dead vegetables and animals on their banks, it can scarcely be doubted that they contain, in suspension, or solution, or both, a minute quantity of organic matter. Still, while some constitutions may never become reconciled to the use of river water, I am not in possession of facts to show that it produces or averts any serious disease. The water in St. Clair, Detroit, Niagara, and St. Lawrence Rivers, is strictly that of the lakes, and approaches nearer to the character of rain water than that of our rivers. The water of the Missouri and lower Mississippi, again differs, as we have seen, from that of the Upper Mississippi, of the Ohio, and of their tributaries, in the great amount of suspended materials. Notwithstanding, but rather in consequence, it is universally regarded as salubrious, and even, by many persons, alterative and medicinal; especially in chronic ailments of the abdominal viscera. To produce any effects of this kind, it should, no doubt, be drunk immediately from the river, and before it has undergone clarification by deposition, or by any artificial process.

III. Well and Spring Water.—The wells and springs in our sandstone formations, especially the springs, afford a transparent water, which is nearly free from mineral impregnation, and is supposed, on that account, to be highly favorable to health. As these districts are never very fertile, their population is not dense, and I have not been able to collect facts for a comparison of the effects of this kind of water, with that which contains a greater amount of foreign ingredients. What has been said on the geology of the Valley, will show where the principal sandstone tracts are to be found. Although the rocks of this formation afford a pure water, the coal and aluminous shales, so often associated with them, not unfrequently impart an impregnation of sulphate of lime, iron, or alumin and potash (alum), giving them a slight mineral taste, occasionally modified, when no iron is present, by sulphuretted hydrogen gas. This kind of water is unacceptable to the taste, and not used when others can be obtained. It has been conjectured that the use of this water produces goitre; and some of the localities of that disease seem to favor the hypothesis: but I shall reserve the question until we come to inquire into the origin of that malady.

In the great limestone tract, which extends, with few interruptions, from Montreal and the southern part of Michigan to the northern part of Alabama, including, of course, the eastern half of Indiana, the western part of Ohio, the central section of Kentucky, and middle Tennessee, the water of both springs and wells is *hard;* that is, abounds in salts of lime, chiefly the carbonate. Its qualities, however, are not the same throughout the whole limestone formation. Between the Ohio River and the lake there are, as we have seen, extensive deposits of diluvium on the surface of the rocks, and the springs and wells which are found in it, afford water less pure and palatable. The same is true of that obtained by sinking wells in the bottom-lands of the rivers, or by resorting to springs which burst out from their banks. The best kind of hard water is that of springs which issue from the fissures and seams of limestone rocks, or is drawn from wells sunk in them. Such is the water drunk by the people of the most populous parts of the valley of the Ohio River and its tributaries. Their ample development and general good health demonstrate, that it is a salubrious beverage. Nevertheless, there is much dyspepsia within the specified region, and calculous affections appear to prevail more than elsewhere. On the other hand, goitre occurs much less frequently than in sandstone, slate, and coal districts.

In the cretaceous and tertiary formations of the south, much of the water is impure — some of it excellent. In all cases when it percolates through sand only, it is soft, and varies but little from rain water. Mobile and Pensacola are supplied by springs of this quality. Further in the interior, where argillaceous formations prevail, and a decomposable or rotten limestone, cretaceous or tertiary, is found, the water is offensive to the taste, and regarded by the people as insalubrious. Here it is, that we find artesian wells, and cisterns of rain water. The latter are becoming numerous, and their water is preferred to any other within the reach of the inhabitants. The cisterns are as deep as shallow wells, and closely covered. They are filled from the cold rains of winter, and the water preserves what is regarded as a low temperature throughout the summer. This water, purer than that of rivers or sandstone formations, constitutes the opposite extreme from that supplied by the slate and limestone regions. Still, it contains traces of carbonate of lime and muriate of soda, the latter of which is more abundant near the sea. It also contains carbonate of ammonia, carbonic acid, and atmospheric air, with excess of oxygen. While in the cistern, it no doubt augments the quantity of its carbonic acid by absorption — that gas, from its weight, sinking into deep places.

IV. The quantity of water drunk by us varies much more than the quantity of food which we take. If not the solvent of our food, it is indispensable to the dilution of it into chyle, and to the constitution of the blood, of which it makes about seven hundred and eighty-three parts in a thousand; it is also a constituent of all the solids of the body, and makes a large proportion of all the secretions and excretions. Thus it is incessantly received into the stomach, whence a portion of it, mingled with the chyme, passes the pylorus, while a larger part, absorbed by the gastric veins, makes its way directly into the circulation; to permeate the system and pass out through the organs and surfaces of excretion. Thus the living body presents a ceaseless circulation of water, as necessary to the manifestation of the phenomena of life, as the circulation of the same fluid through the atmosphere, and on the surface of the earth, is to the support of organized nature generally.

Several circumstances or conditions influence the quantity of water which we take at different times.

First. In proportion as it is discharged more copiously through the skin, thirst is increased, and we drink more freely. Thus the heat of summer, by augmenting perspiration, causes drinking; which is greater in the southern than in the northern part of the Valley; in summer than in winter; in a dry than a humid atmosphere, as the latter retards exhalation from the skin.

Second. Exercise, by increasing perspiration, and still more by augmenting exhalation from the lungs, leads us to a more liberal use of water.

Third. A liberal use of salt, such as a diet of animal food requires, excites thirst, and prompts us to drink more freely; the salutary effect of which is, to dilute the solution of muriate of soda, before it enters the blood, of which it is a constituent. Animal food, moreover, containing but little moisture, requires for its solution a good supply of water; and, requiring it, promotes thirst.

Fourth. On the other hand, a vegetable diet, embracing but little salt and much water, diminishes thirst, because drinking is comparatively unnecessary.

Fifth. Several medicines, by increasing secretion, render drinking necessary, and prompt to it by augmenting thirst. Thus saline hydrogogue cathartics, diuretics, and diaphoretics, promote drinking. One reason why a large dose of opium produces the same effect, is the increase of insensible perspiration which it occasions.

Sixth. Several morbid states of the body promote thirst, for reasons which are quite obvious.

1. In diabetes, when the secretion from the kidneys is profuse, the thirst is great.

2. In diarrhea, which tends to drain the blood vessels, the same desire is generated.

3. In dropsy, when incessant secretion in the cellular texture is going on, there is much thirst.

4. In dyspepsia, connected with acidity, thirst is generated, that the acid may undergo dilution.

5. In fevers, the heat increases thirst, and by prompting to copious draughts, which circulate freely throughout the system, the temperature and febrile excitement are lowered. If ice be taken into the stomach, under such circumstances, it will not bring down the heat of the body like a great quantity of water, although twenty or thirty degrees above the freezing point; because the volume of the former is small, while that of the latter is large, and is carried to every part of the body. Should an individual be attacked with fever under circumstances which precluded medical assistance, he might save his life by taking incessant draughts of water; which should not, however, be so cold as to chill the stomach, and make it necessary to limit the quantity. The temperature most favorable to these salutary effects, is from sixty to seventy degrees of Fahrenheit.

The various kinds of water which I have enumerated, have their respective tastes; but, as that liquid, when absolutely pure, is tasteless, it follows that the particular sapor of each kind, is derived from the matters which it holds in solution or suspension. Those who have been long accustomed to one kind of water, cease to notice anything except its temperature; but immediately recognize a different kind, when it is taken into the mouth. In general, the new kind is unpleasant. As this is reciprocal with two individuals, who exchange the kinds to which they have been accustomed, it only proves that in drinking we prefer the water which imparts no taste.

Much is said by the people, on the comparative salubrity of different kinds of water. In this dispute, the fact should not be overlooked, that nearly every substance dissolved in the water drunk in any part of the Valley, is a constituent of healthy blood, or of the solids formed out of that fluid. Thus, he who drinks hard water from wells, or from springs which burst out in limestone formations, takes in scarcely anything that does not make a component part of his food, and that is not a necessary element of his blood. Now it can scarcely be admitted, that such substances can be injurious to health; or that it can make any difference whether they are received into our systems with our food, or our drink. When any one of these ingredients, as iron, sulphur, or common salt, from existing in large quantities, imparts its peculiar taste, the water thus impregnated is called mineral, and is not much drunk, except for the cure of diseases. Nevertheless, it is possible, that water not thus rendered repulsive, may sometimes be the vehicle in which certain substances, necessary to the constitution of the blood, may be introduced in such quantities as to prove injurious; concerning which I shall have occasion to inquire when treating of our diseases. Meanwhile, this is the place to remark, that when an individual has been long accustomed to one kind of water, a change to another is not made without temporary inconvenience. The consequence sometimes is, a deranged state of digestion; but more commonly diarrhea or costiveness—generally the former. This, however, proves nothing relative to the absolute salubrity of different waters; as the opposite change, by another individual, may be followed by effects equally unpleasant.

V. It cannot be doubted, that water sometimes holds in suspension or solution, matters positively injurious to health; but these are special and limited cases. Thus, when it has percolated from marshes, it may carry with it malaria, dead organic matter, or animalcules, which may or may not be injurious to health. An instance of the last was mentioned in speaking of the medical topography of Jackson, in the State of Mississippi.* And wells, sunk in alluvial grounds, which abound in decaying vegetable remains, may afford water impregnated with insalubrious matters. Finally, as it circulates through the earth, water may dissolve arsenic, or some of the salts of lead, copper, or barytes; and thus, without disclosing its presence by a characteristic taste, act as a slow poison. I am not aware, however, that any part of the Valley has yet presented a case of this kind. It is a curious and interesting fact, that we so seldom find these and other poisonous minerals, dissolved in the water of springs and wells, while carbonate and sulphate of lime, sulphate of magnesia, muriate of soda, oxide of iron, and sulphur, all constituents of the blood, and all harmless, so far, at least, as any immediate effect is concerned, are common; and often exist, in perceptible quantities, in water used for culinary purposes.

Many springs and wells, containing a slight impregnation of sulphureted hydrogen gas, are used for drinking and culinary purposes. I am not aware, that they exert any deleterious influence. Saline water, strongly impregnated with the same gas, is sent in large quantities, from the Blue Licks, in Kentucky, to the States of the south-west, where it is drunk freely in the morning; and it seems to be a salutary beverage.

VI. Water that flows through leaden pipes, in which it often stands for a time, or is kept in cisterns lined or covered with lead, is *liable* to acquire a poisonous quality. This will not happen, if it be free from air, and the atmosphere be excluded; but such cases do not occur in the common operations of families and communities. When it contains air, which is always the case unless it be driven off by art, the metal will become corroded; and a portion, in the form of a salt, will be dissolved in the water. Now this occurs, most certainly, where the water is very pure, that is, free from all saline substances; such as that which falls in the form of rain or snow, or issues from strata of sand which have no others above them. When saline substances, such as muriate of soda (common salt), or sulphate of lime (gypsum), are present, the empoisoning of the water is prevented. They promote the formation of an insoluble and impermeable film of white lead (carbonate), on the surface of the pipe or cistern, and the water remains pure. These salts are present in all our river and well water, and in all our spring water, except that from beds of sand supplied by rains. Hence there

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* See page 204.

is little danger from the use of pipes and cisterns of lead, except in connection with rain water, or spring water, flowing from rocks or deposits of sand. But it has been ascertained, that the presence of carbonic acid in water, promotes the formation of so great a quantity of carbonate of lead, that the water may become poisonous. This will chiefly be found in wells that are but little resorted to, and in cisterns. In the former case, the sulphate of lime, the muriate of soda, and other salts, are generally in such great quantities, that the danger is small; but in cisterns filled, as is done in the south, during winter, for use the ensuing summer, the danger, if there be any lead connected with their lining or covering, or with the pump by which the water is drawn up, may be considerable; for, as this water is almost free from saline substances, and contains atmospheric air, entangled in its fall, and carbonic acid gas, absorbed afterward, all the conditions favorable to its speedy action on lead are present. As the the planters of the south are multiplying their cisterns, these facts ought to be universally known.*

VII. I have already stated, that the water collected during the winter, in these cisterns, is preferred to that which falls in summer, because the people say it is cooler;† but I do not know that this alledged lower temperature is a fact. In the latitude of thirty-one degrees fifty-two minutes, I found the heat of one of them, in the month of June, seventy degrees of Fahrenheit, and the rains of that season could scarcely be warmer. It seems probable, that the true but unrecognized reason is, that the water which has lodged in the cistern for several months, has absorbed carbonic acid gas, and thus become lighter and fresher to the taste. The more air a water contains, all other circumstances being equal, the more acceptable it will prove both to the palate and the stomach. Thus the boiled water which, in limestone regions, some persons drink, is never pleasant, as the atmospheric air and the carbonic acid are driven off. The lime, held in solution by the latter, is deposited; but, although the water is rendered flat to the taste, it does not become entirely soft, as the muriate of soda and sulphate of lime remain in solution.

VIII. Artificial mineral waters, made by forcing carbonic acid gas into spring or river water, to which a small quantity of carbonate of soda had been previously added, are consumed abundantly, in all our towns and cities. They are always drunk at a lower temperature than our spring or well water. These beverages, unquestionably salubrious, may offend the stomach: *First*, by being too cold; *Second*, by distension of the organ, when no portion of the carbonic acid is thrown up by eructation; *Third*, by the sirups which are commonly added to render their taste more agreeable. Bad consequences from these waters, are most likely to fall on those who labor under that form of dyspepsia, which is unaccompanied with inflammation, and to them only. Such persons should take them not very cold, using a stimulating sirup, and an excess of soda.

It sometimes happens, in summer, that drinking the largest quantities of

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* Christison on Poisons, Chapter 17. † Page 206.

cold water will not allay, but rather increase thirst. Under such circumstances, whisky or brandy will give relief; but tea or coffee is preferable — the heat almost instantly removing a sensation which cold seemed to augment.

SECTION IV.

ALCOHOLIC BEVERAGES.

I. Morning Bitters and Mint Juleps. — From the first settlement of the Valley, until within fifteen or twenty years, these potations were almost universal. They were generally composed of whisky, and were very commonly drunk by all the members of the family, old and young, male and female. The custom, originating east of the mountains, and sustained by habit, and the love of stimulation, was justified by its alledged advantages as a preventive of autumnal fever. Although not yet entirely broken up, it has been discontinued by a large majority of its advocates; and neither autumnal fever nor any other disease, has increased in consequence of the reform. In any and all cases, where a morning stimulus is necessary to fortify the stomach against external influences, it cannot be doubted, that a small cup of strong, hot coffee is altogether preferable.

II. Grog. — The practice of drinking whisky or brandy and water, before or immediately after dinner, was once general. The whisky or brandy bottle, especially the former, was as regularly transferred from the sideboard to the dinner table, as the vinegar cruet. But this practice is now nearly obsolete; and if the bottle still find a place on the tables of many of our steamboats and hotels, none but those who are strongly prone to intemperance, have the courage to touch it. Formerly, men drank before dinner to whet their appetites, and after dinner to assist digestion. The fashion, as I have said, has passed away, and still they eat heartily and digest well. In this kind of drinking, women and children never participated to the same extent, as in the dram drinking before breakfast.

III. Wine. — The consumption of wine has, in latter years, greatly decreased. It was once a regular forenoon entertainment, presented to those who called, especially ladies, and was served up with cake; it was also on the dinner table, and was held to be an indispensable adjunct of hospitality and good cheer, at evening parties of ladies and gentlemen. At present, it is rarely seen in the forenoon, is drunk sparingly at dinner parties, and often omitted at evening entertainments. In general, the wines drunk in most parts of the Valley, have been sherry and Madeira, adulterated and rendered highly stimulating with brandy — itself a factitious compound. In Louisiana, and other parts of the south, especially among the Creoles — on the whole the most temperate part of our population — a great deal of claret is consumed.

The successful cultivation of the vine, in different parts of the Valley, above all, in the country around Cincinnati, has originated the manufacture of wine — not from various ingredients — but from the unadulterated juice of the grape. The experiment has been carried so far, as to justify the expectation, that the production and consumption of native wines, will become extensive and permanent. In this anticipation, which carries with it another — an abatement in the use of adulterated and artificial wines and of distilled spirits — it will be proper to say something of the character of the wines, which the soil and climate of the Valley afford. By Nicholas Longworth, Esq., whose efforts to cultivate the grape and manufacture wine, have been, without regard to expense, continued with unabating zeal for nearly thirty years, I learn, that every attempt to make wine from the grapes of the old world, has been a failure; and that he and all others in the West are now limited to two native vines, one called Catawba and the other Herbermont. I cannot give their botanical names. From these grapes, and chiefly the former, two or three varieties of wines, resembling the German hock, and an excellent champagne, are manufactured. It is estimated that, within a radius of ten miles from Cincinnati, five hundred acres are planted in vineyards, and the cultivation is rapidly increasing on both sides of the Ohio river, as far down as Louisville. It will be interesting, at a future time, to observe the results of an extensive substitution of these mild and simple wines, for the more ardent beverages now in general use.

IV. Bar Room Drinking.—While family and hospitable drinking have thus declined, bar room drinking, in many parts of the Valley, has held its own. Ashamed to keep intoxicating drinks in their houses, men resort to dram shops, and guzzle draughts of brandy and water, with loaf sugar, mint, and ice. Fortunes have been made by many who have kept these establishments in all our larger cities. The times for this kind of drinking are the morning, the forenoon, the afternoon, and the night. Here it is, secured from public observation by screens, that a representative from half the families of every town in the middle and southern zones of the Valley may be found; here it is, that others pledge themselves to oppose the municipal legislation, which would suppress the fountains, at which they continue to drink until various diseases are generated and their constitutions destroyed.

V. Malt Liquors and Cider. — These were formerly in extensive use, as table drinks, in the middle and northern parts of the Valley. In latter years, their consumption in families has decreased; but large quantities of the former are drunk in the beer houses with which all our towns and cities abound. They are the cherished beverages of our German and English immigrant population. Cider, formerly manufactured and consumed in large quantities by the people of the State of Ohio, is now in less general use.

VI. Necessity and Effects of Alcoholic Drinks. — This seems to be the place for inquiring into the physiological necessity of drinking, and its pathological effects on the health and constitution.

It cannot, I think, be doubted by any physiologist, that human nature requires, for its full corporeal, intellectual, and moral development — its activity and efficiency—something more than the elements that supply the waste of the blood, which is perpetually exhausted, of certain principles by nutritive secretion and the function of respiration. Hence, there is implanted in the physical system, a desire for stimulants, as well as a desire for food and water. The question is, whether this want cannot be supplied, and the desire gratified, without a resort to alcoholic drinks? This question may be conclusively answered, in either of two ways — the *a priori* and the *a posteriori*, of logicians. If alcoholic drinks had been necessary to the well-being of man, they would have been made productions of nature; but they are not the productions of nature; and, therefore, they are not necessary. So much for the *a priori* view of the matter. If we resort to the *a posteriori* argument — if we turn to experience, and that, too, the most extended, diversified, and accurate, we find that thousands of individuals attain to full bodily and mental vigor, without the stimulus of alcoholic drinks; and thus, by their coincidence, the two modes of proof establish, beyond the possibility of a doubt or cavil, that such drinks are unnecessary; at least, when the stimulants which nature has provided, can be obtained. These latter stimulants are common salt, an element of the blood, not less than a stimulus; the various aromatic and acrid substances, which man has sought out and instinctively mingled with his food and drinks, under the name of condiments; and, lastly, tea and coffee. These are all the physical stimulants which his system demands for its full perfection — all that are necessary to satisfy his desires, when kept unperverted. Adapted, by infinite wisdom, to man's wants, not less than to his instincts and appetites, he seldom uses them to excess; and when he does, their injurious effects bear no assignable proportion to those of the artificial substitutes, which his ingenuity has manufactured out of sugar, now known to be the only source of alcohol.

The question here arises, why has man substituted this factitious and baneful stimulant, for those which the hand of a beneficent Creator has scattered around him? The answer is, because the excitement which it raises in him, is of a more intense kind, than that which they produce; an evidence that its use is both unphysiological and pernicious. It may be asked, however, whether alcohol may not be taken in such small quantities, as to be made a safe and salutary substitute for the *natural* stimulants? I answer, that, theoretically, it may; but, practically, it cannot; for if the natural stimulants be withheld, the desire for this, as soon as its effects are experienced, becomes ungovernable, and it is taken to excess. This is the case, as we shall hereafter see, with the Indian. All attempts, therefore, to replace the natural stimulants by alcohol, without using the latter to excess, must necessarily fail. The stimulation which it imparts, moreover, is not of the same character, as that raised by the natural agents, and no individual would enjoy the sound health of body and efficiency of mind, under its *exclusive* dominion, that he would enjoy under the influence of those stimuli, which the bounty of nature offers to him.

The resort to alcoholic drinks is, then, gratuitous, and the injuries they inflict on the human race are not, like those from changes of weather, or accidental violence, inevitable, but avoidable. Yet, how can they be avoided? The answer is obvious. By refraining from the use of what, according to natural laws, is not required; and adhering to what is both demanded and provided. The cause of mischief being obviated, the effect would cease.

It is argued, however, that there *are* circumstances under which alcoholic drinks are specially beneficial. I may grant this; but it puts their use on a new principle, that of hygienic, or, rather, medicinal influence, and limits the practice of taking them to the assigned conditions; for to be effective on *occasions*, they must not be used *habitually*. But let us inquire into these emergencies. *First.* It *has* been held, that morning bitters, which, I have already said, were formerly in general use in families, tended to prevent the autumnal fevers which prevail in all parts of our country. But the extensive discontinuance of the practice, without any observed increase of those diseases, shows that the theory was erroneous. *Second.* It is well known to the physicians of New Orleans and Mobile, that the victims of yellow fever are chiefly those who drink freely. Alcohol has no preventive power, then, over that disease; nor does it diminish the mortality among those who are attacked. *Third.* It is equally well known, that other summer and autumnal epidemics, as cholera morbus and dysentery, are not warded off by alcohol, whatever may be its value in the treatment of certain cases of those diseases. *Fourth.* If a moderate use of brandy or whisky, had any preventive efficacy in Epidemic Cholera, it was greatest in those who had previously drunk least, and only useful when the disease was forming in the system. *Fifth.* It is known to all the medical men of the Valley, that drinking has no power to keep off rheumatism, pneumonia, pleurisy, bronchitis, and other winter inflammations; and that those who have drunk most, are most likely to die when attacked. *Sixth.* Exposure to the elements, is an assigned condition requiring the use of alcohol. But the evidence is against its use, especially as compared with food and coffee, under cold or wet, and with lemonade or tea, under great heat. Of this we have already said something, in speaking of the employments of different classes of men; and shall furnish additional proofs, when treating of our diseases.

Thus it appears, that neither the habitual nor the occasional use of alcoholic drinks, is necessary or beneficial; and I come now to show that they are pernicious.

That a man might drink a moderate quantity of distilled spirit, wine, or malt liquor daily, and attain to old age, without infirmity, either of body or mind, arising from that habit, is undeniable; for in the Valley, as elsewhere, we have such examples. The sound health, serene mind, and advanced age, do not, however, come from the drinking; are only not prevented by it. If all drunk under such restrictions, the evils of intemperance would be unknown. Unfortunately, but a part of those who drink, thus limit themselves; the rest go into excesses, that are pernicious to health in proportion to their degree, and to the liability of the constitutions of those who practice them to become impaired by inordinate indulgence. Now, there must be a physiological reason for this fatal tendency to excess; and what is it? To answer this inquiry, we must refer to the effects of alcohol on the nervous system. These are two-fold — stimulating and narcotic. For the sake of the former effects only, is it used as a beverage; but they cannot be obtained apart from the latter. Slight stimulation, it is true, may be followed by a narcotism so slight, as not to affect the consciousness of the individual; but still his nervous system receives a narcotic or stupifying impress, conformably to the great law of relation between narcotic substances and that system. By repeated indulgence, the nervous susceptibility loses somewhat of its acuteness, and becomes proportionably insensible. Hence the necessity for augmenting the dose, when the object of the individual is excitement. But its increase works out a further reduction of sensibility, and renders new augmentation necessary. In this manner, a signal pathological change is wrought out in that portion of the system; which not only presides over the rest, but is the seat of all the senses, appetites, and desires of the body, and the immediate instrument of the mind. Thus, while the individual may not be conscious, on any succeeding day, of higher stimulation, from not feeling greater excitement than he felt the day before, his nervous system, through alternate paroxysms of excitation and stupefaction, is brought into a state of actual and peculiar disease; for which he finds no palliative, but in a new resort to the narcotic stimulant which produced it. Thus, the habit of drinking to excess, is not like the habit of an awkward movement of the hand or foot, of taking the same seat at the table, or of seeking the company of a particular person on the return of the same day of the week; it is not a mere acquired peculiarity, within physiological limits; but — combined with what may be called an alcoholic diathesis — an actual, inveterate cachexy. In this constitutional disorder, the nervous system is not alone involved; for the blood is deteriorated, and all the functions of the body, with the faculties and emotions of the mind, are more or less implicated.

I shall not affirm, that in this condition, the individual is more liable, than in sound health, to be seized with prevalent and epidemic diseases; but experience has demonstrated, that when attacked, he is much more liable to die. From this diathesis, moreover, several formidable diseases are set up, independent of external causes, and advance more or less rapidly to a fatal termination. The most serious of them are, dyspepsia, combined with chronic gastritis; diarrhea, connected with ulceration of the bowels; inflammation of the liver, and jaundice; dropsy of the extremities, abdomen, chest, and pericardium; sore eyes, atrophy, palpitations of the heart, tremors of the limbs, convulsions, palsy, delirium tremens, and suicidal monomania.

Every physician of the Valley, must have met with several of these diseases, as the consequence of intemperance in the use of ardent spirits. Of the peculiar maladies generated by wine, we know but little, as the number of wine bibbers is small. Nor can I speak decidedly of the effects produced by malt liquors; which, however, have been observed here, as elsewhere, to be fullness of habit, a kind of hypertrophy of the cellular tissue, dropsy, sluggishness, drowsiness, and apoplexy.

Alcoholic beverages are much more pernicious to the constitutions of the young, than of those in middle or advanced life. Very few young men, with habits of excessive drinking, reach the meridian of life; being cut off by convulsions, apoplexy, or some disease rendered incurable by their alcoholic cachexy. Very few women, except the abandoned, or the lower classes of Irish emigrants, fall victims to intemperance; for excessive drinking by females, is exceedingly rare in every part of the Valley. I have known but one woman to die with delirium tremens, and she was from England. Among the hygienic means of averting the habit of excessive drinking, I know of none equal to the use of tea. To this we may, in part, attribute the escape of our female population from intoxication; and I have rarely seen a young tea-drinker of the male sex, become in later years, the victim of alcoholic stimulation.

We may presume, I think, that the effects of alcoholic stimulation are modified by climate, as we know them to be by the temperaments and idiosyncrasies of those who drink, and also by the composition of the drinks themselves; but these diversities can be best studied in connection with the diseases they produce. In this place, I shall not attempt even an enumeration of the maladies which alcohol, as a predisposing, exciting, or aggravating cause, is known to generate or render fatal; but in the progress of this work, they will be pointed out; and it will then appear, that throughout the Interior Valley, notwithstanding a decided amelioration in the habits of the people, this poison continues to be a prolific source of disease.

SECTION V.

TOBACCO.

The consumption of snuff in the Valley of the Mississippi, except by the French of Louisiana and Canada, is quite limited. Coarse snuff is generally prefered to fine; and hence the nasal twang, which results from the accumulation of the fine powder in the posterior nares and the sinuses of the face, is not often heard. Snuff is more used by the aged than the young, and by men than women. When a dry and not very coarse article is taken freely, it may be seen adhering to the pharynx; and, descending into the stomach of the dyspeptic and nervous, it contributes to aggravate their disorders.

In many parts of the south, women and girls have a fashion of rubbing their teeth and gums with snuff. They chew the end of a green twig, until they mash it into a kind of brush, which they dip into the snuff box, and then rub their teeth with it. This operation is known through that region under the name of "dipping." The practice, like that of eating slate pencils, chalk, or clay, often spreads through families and female schools; so as to constitute a serious and disgusting evil. No doubt much of the powder, finding its way into the stomach and lungs, contributes to disorder both, and to derange the nervous system generally.

Smoking prevails to a great extent. In our towns and cities, cigars are used almost entirely; in many, indeed most parts of the country, the pipe maintains its ancient supremacy. If the same one be repeatedly used, it becomes foul, with a deleterious empyreumatic oil, which contributes to the energetic effect which tobacco exerts on the system; it would, therefore, be more pernicious than cigars, were not the constitutions of the country people firmer than those of the city. Our Germans are great smokers, and prefer the pipe; but most of them are hard laborers, with constitutions of little susceptibility. In our towns, and older-settled parts of the country, but few women smoke; but in frontier and thinly-peopled places, inhabited by immigrants from the old southern states, the custom still prevails.

Cigar smoking in our towns, has been charged with promoting alcoholic intemperance. They are undoubtedly associated, but may be the twin offspring of idleness, fashion, and conviviality. Still it is true, that young men sometimes seek in whisky or brandy, relief from the pernicious effects of tobacco; and it may be useful, therefore, to tell them, that a glass of lemonade, or any other acid drink, is a far better corrective.

Chewing is still more prevalent than smoking. Some individuals follow both, but a majority only one. Chewing, I believe, is almost entirely confined to the male sex. The cheapness of tobacco in every part of the Valley, resulting from its extensive cultivation, no doubt, contributes to an excessive use.

Our boys begin the use of tobacco, by chewing or smoking, at an early age; many as early as seven years; a large number before puberty; and a great majority of all who ever use it, acquire the habit before they are twenty-one. But few persons engage in its use after their fortieth year. At whatever period the habit may be formed, it generally continues through life; and the earlier it is established, the more inveterate is its character. The predisposing cause of this custom is the constitutional desire for bodily excitement; concerning which I need not repeat what was said when treating of alcoholic drinks. The most efficient exciting cause is fashion, and instinctive imitation of our seniors and companions. The sustaining cause is a permanent modification of the nervous system. It is common to hear the custom of using tobacco and that of alcoholic drinking, spoken of in nearly the same language of reprobation; but physiology recognizes, along with the analogies, several diversities of action and effect.

First. The first impress of tobacco on the nervous system is far ruder, than that of alcoholic drinks. It is characterized by great muscular debility, feeble pulse, nausea, vertigo, and tremors. While it stimulates and irritates the mouth and throat, it produces general prostration. The constitutional effects of alcohol, on the other hand, are those of excitement, followed by slight narcotism. *Second.* Tobacco does not raise excitement in the mental and moral faculties, but the reverse; while both are transiently excited and disordered by alcohol. *Third.* The abuse of tobacco does not generate inflammation of the stomach, liver, or brain—a common effect from excess of drinking. *Fourth.* It does not, like alcohol, lead to epilepsy, apoplexy, and palsy. *Fifth.* It does not produce the dropsical effusions which, sooner or later, make their appearance under abuses of alcohol. *Sixth.* It does not originate delirium tremens and suicide. *Seventh.* It does not, like alcoholic stimulation, give fatal effect to other remote causes. *Eighth.* It differs from alcohol in this, that the habit of resorting to the latter may be formed after middle life. *Ninth.* As a fact, I may mention, that fewer leave off the use of tobacco than of alcohol; but how much of this is purely physiological, and how much moral, or a result of the perception of the evils of the latter, I cannot say. *Tenth.* After both habits have become fixed, the continuance of the use of tobacco seems to depend more on the demand of the *part* on which its makes it impress — that of alcohol on the requirements of the whole constitution.

We must now turn to the admitted evils to health, resulting from the use of tobacco: *First.* It is most injurious to those of a bilious or nervous temperament; less to the sanguine, and least of all to the phlegmatic. *Second.* Its violent effects upon the nervous system, in early life, grow less with age and the continuance of the habit; but, in a great number of persons, it maintains permanent weakness, and irritation of the nervous system. *Third.* It impairs the functions of the stomach, giving rise to indigestion and acidity, with attacks of sick headache. *Fourth.* It sometimes arrests nutrition, and keeps the individual in a state of comparative emaciation, with debility of the muscular system. I know a gentleman who chewed tobacco through a long life, and was always remarkably lean. When about seventy-five years of age, he discontinued its use, and in the course of a year, became fleshy, and even rather corpulent, though, in everything else, he lived as before.

The effect of keeping down the flesh, is generally attributed to the drain of saliva which it occasions, and this may sometimes be one of the modes in which it operates; but its greatest influence is on the nervous system. This effect is universal, but not always injurious. Certain constitutions display it at all times, but others only become sensible of it when the drug is withheld. There then arises a nervous irritability, accompanied by a desire, under which the habit is resumed.

A gentleman who had followed the sea for many years, and practiced chewing the whole time, determined, when he became a landsman, to break himself of the habit; but, after abstaining for two years, during which, as he assured me, the idea of tobacco was never absent from his mind, he resumed it, and his nervous system became pacified. Such facts conform to the law, that the difficulty of breaking in upon a physical habit, is inversely as the facility of forming it.

Nothing in the present state of society, justifies the expectation, that tobacco will go out of use. Its universal adoption indicates a universal propensity, which it gratifies. When the habit is once formed, the motives for breaking it, are generally insufficient to sway the will of the individual; and thus he at last becomes a *venerable* example to the rising generation. Thus the practice is made, as it were, hereditary. Notwithstanding this discouraging view of the evil, it should be resisted in every practicable way. Commencing in youth, it ought to be met by the discipline appropriate to that period of life. Parents should forbid it in their sons, masters in their apprentices, and all literary institutions in their pupils. Many would, by this course, be kept from forming the habit, until they would pass the period in which it is generally established; and their example would exert an influence on the succeeding generation. In this way the evil might be diminished, but not eradicated. Meanwhile, it is the duty of medical men, to point out the injury which they may observe it to be exerting on individuals, and insist on its discontinuance; or lay such restrictions on its use, as to diminish its pernicious effects. One restriction is to lessen gradually the quantity consumed; another, to use weaker tobacco; a third, not to use it when the stomach is empty.

CHAPTER III.

CLOTHING, LODGINGS, BATHING, HABITATIONS, AND SHADE-TREES.

SECTION I.

CLOTHING.

The male population of the Valley, throughout its whole extent, are generally well clothed, as far as respects protection from cold. Linen next the skin is rare, except in summer, and is then almost limited to the wealthier classes. Muslin is in general use. In winter, flannel next the surface of the body, is more extensively worn than formerly. Some individuals wear it throughout the summer; but a greater number substitute muslin. Both the woolen and the cotton fabrics, tend to preserve the skin from the sudden reductions of temperature by the action of wind, when the individual is perspiring; while linen, from its readier conducting power, permits both the heat and moisture, to be more rapidly carried off. There are skins, however, so irritable, and others so prone to perspiration, that linen is preferable for them throughout the year. At all seasons of the year, the flannel, or muslin, or raw silk, that is worn next the skin, through the day, should be taken off at night; and, by being turned inside out, be allowed to exhale the secretions of the skin with which it has become impregnated; a practice not generally observed, though decidedly salutary. The moccasons of buckskin, so common fifty years ago, havenearly disappeared; and substantial shoes and boots of tanned leather, are now in universal use. They are seldom made water-proof, or worn double, except in cities, and there by a small number. The former quality, makes the feet damp from their own perspiration, and keeps them so — the latter custom, subjects the individual to the danger of taking cold, whenever he happens to be exposed, with only a single pair. There can be no doubt, that the common method of protection is most salubrious. The boys of the country run barefoot for eight months of the year, until they are twelve or fourteen years old; a custom well calculated to harden their constitutions.

The dress of the female population of the Valley is not, in general, as well adapted to the preservation of health, as that of the male. It abounds much more in cotton and silk; which in winter are often insufficient. The practice of wearing flannel next the surface is not so universal, and the want of a close adaptation of clothing to their limbs, whereby they are exposed to the sudden changes of a variable climate, is no doubt often a source of disease. For several years past an amelioration in this respect has been going on, and fashion, more governing in female apparel than in any other custom of the world, seems likely to render the use of muslin or flannel drawers universal. So many obvious considerations unite in favor of this addition to female raiment, that the hope may be cherished that, once introduced, it will become permanent.

The use of corsets, though not universal, has been very general, but is said to be declining. In the country, the exceptions are more numerous than in the towns and cities, even among women who labor equally hard. Much argument, declamation, and raillery have been directed against this article of apparel; but it has maintained itself in spite of all. The truth is, that the inferior muscularity of the trunk of the body in females, and the greater amount of cellular, adipose, and glandular matter covering the muscles, than in males, seems to suggest the corset as a natural and necessary support. A requirement much less urgent, on the part of the other sex, suggested and maintains in use, the waistband and closely-buttoned vest. The true objections to the corset do not involve its use, but its abuse. *First.* It is often put on girls before they have gotten their growth. *Second.* It is not always fitted to the form. *Third.* In many instances it is worn so tight, as to displace the abdominal viscera, restrain the due action of the respiratory muscles, and prevent the full inflation of the lungs. These abuses have their origin in the tastes of individuals; and do not spring from the mechanism of the jacket itself. It is certainly more feasible to correct them, than to banish it — easier to raise a public opinion among women against tight lacing, than against an article of dress which, properly used, they find comfortable, supporting, and in no wise injurious; while it enables them to fix and adjust the other parts of their apparel; as the trunk of the body constitutes the *point d'appui*, of all the movements of the head and extremities.

The shoes of our women, both in town and country, but especially in the former, are far from constituting an adequate protection, except in the south, or during hot and dry weather. They cover too small a part of the foot, and the materials of which they are composed, are generally too thin and permeable to water. I am quite convinced, that where one has suffered from the manner of using a corset, many have suffered from the form and material of their shoes. Their hosing, also, in the middle and northern parts of the Valley, is quite insufficient; being generally of cotton or silk, when that of wool, as a greater non-conductor of heat, is indispensable to the warmth of the feet and lower extremities. In the country, woolen stockings are in more general use; but, still, cotton is very often worn under circumstances which should forbid its use.

The fashion of occasionally exposing the neck and upper part of the chest, which the same individuals ordinarily protect from the action of cold air, is injurious to the health of the lungs; and requires a removal of the dress from the top of the shoulders, over which it should be suspended, to the deltoid muscles; where it is kept, by a tightness, which materially interferes with the action of those muscles, and the movements of the arms. Thus, while the modesty natural to women is violated by this fashion, it is equally repugnant to sound physiology.

The dress of our children is often liable to objections. What I have to say relates to the colder parts of the Valley, and more to cities than the country. In the latter, children spend much of their time in the open air, and, by common consent, are held to be hardier. In town, they remain more in close and heated houses through the cold weather, and when they are sent out, are often inadequately clothed. The fashion of exposing their arms and the superior parts of their chests during youth, is often injurious. Man was not made to have his hands and face clothed, but he was made, to have the other parts of the body covered. Animals and birds have a natural protection of hair or feathers, and man, in all climates and all states of society, has shown an instinct to clothing. These two facts demonstrate, that clothing is physiological; and, if so, it should extend to all parts of the body which can be covered without interfering with their functions; and the only exceptions are those just mentioned. It is physiologically absurd to say, that by exposure, the whole surface of the body would come to bear the cold as well as the face, which must of necessity be exposed. Parents, then, should not expose their children without protecting what nature requires, and her Author intended, should be protected. The practice, moreover, of allowing the clothes of little children to fall off their shoulders, and be kept up by compression over the shoulder joints, is still more objectionable in them than in young women, as it interferes with the proper development of their arms. The secret of success, in forming the constitutions of children, as far as clothing is concerned is, *First*, To cover the whole surface of their bodies and their limbs separately. *Second*. To see that their dress is warm in winter. *Third.* To take care that no part of it compresses them. Thus protected, they should be encouraged to go into the open air, frequently and freely, even in the coldest weather.

SECTION II.

BATHING.

Bathing is far from being general in any part of the Valley. On the shores of the Gulf, and at the watering places of the interior, there are bathing houses, to which a number of people annually resort in summer. Those who live near our rivers and the shores of the Northern Lakes, occasionally bathe. In most of our larger cities, there are bathing establishments for both sexes, to which individuals, chiefly of the more wealthy classes, have recourse; and, finally, many individuals have family bathing-rooms, both hot and cold. Still, an overwhelming majority of our population seldom bathe at all. Of the efficacy of daily bathing, in the preservation of sound health and a hardy constitution, there can be no doubt; and it is much to be regretted, that the practice cannot be made more general. A very good and not inconvenient substitute for immersion or showering, may be found in sponging or sprinkling the surface of the body, on rising in the morning, all the year round; or, in the winter, standing at the window and taking an air bath, which should not be prolonged after a slight shuddering has commenced. In all cases the skin should be well rubbed, immediately after the application of the water or the air, with a coarse towel. Our large cities, from New Orleans and Mobile, to Pittsburgh and Montreal, ought to have public cistern-baths, for the gratuitous accommodation of the poorer laboring classes, so many of whom, when sick, are supported at the public expense in our alms-houses and hospitals. Whatever tends to preserve their health, diminishes the poor taxes, not to refer to higher motives, which are obvious, but do not come into the plan of this work.

SECTION III.

LODGINGS.

Many persons in the middle and northern parts of the Valley, sleep, through winter, in rooms warmed by stoves or open fireplaces, but a greater number lodge without fire. The general opinion is in favor of the latter, as far as health is concerned. If fire be used, the open chimney is better than the stove, as favoring ventilation. If a stove be used, a screen should be interposed between it and the head of the bed, to intercept the radiating heat, and evaporation should be maintained. It is better to burn wood than coal in the bed-chamber; for, as the latter is dying away, and the draft up the pipe has nearly ceased, a quantity of carbonic oxide is apt to escape, and contaminate the air of the room. Thus many persons who sleep in close rooms, with stoves supplied with coal, have troubled dreams; and awake in the morning with headache. The people of the zones, of which I have spoken, and, indeed, of almost the whole Valley, are less divided in opinion as to their beds, than they are in regard to fire in the bed-rooms. Feather beds are almost universal—indeed, are met with nearly down to the Gulf; and, in most of the Valley, the people lodge upon them in summer as well as winter. Even children, not less than older persons, are often subjected to this kind of lodging. In mild weather, feather beds should never be used; and, in winter, those who keep fire in their rooms, and those who live in the south, should not sleep on them. A hard bed, of curled hair, straw, husks of Indian corn, or long moss, is much to be preferred, as promoting the density and strength of the muscles, and hardening the skin. Persons who have been lodged on hard beds from their infancy, greatly prefer them. What are called "weakly" children should sleep on no others. Mechanical pressure is the natural stimulus of the skin and muscles; and cannot be withheld at night, without detracting from their firmness and vigor. The rule should be, to resort to feathers only for warmth; and under all circumstances which admit of that, in an adequate degree without them, they should be dispensed with. This rule, rigidly observed, would banish them entirely from the southern zone of the Valley, and limit them to the winter in the middle and northern.

The extensive, and especially the summer, use of feather beds, in the Valley, may be traced back to the practice of our English ancestors; for family customs, not less than nursery tales, are traditional. But, in Great Britain, the summers are proverbially cool; and, hence, what may there be very well, may be prejudicial here. It is necessary, however, that we should lodge warm. To sleep cold is exceedingly injurious to health; for it is natural, that is physiological, for the perspiration, sensible or insensible, to flow freely while we are asleep. Repose, silence, and the absence of mental emotion, favor it; and if it be suppressed by cold, injury to health ensues. It is particularly injurious for the surface of the body to be uncovered through the night, and especially during the latter part. Hence it is beneficial, in summer, to sleep in such night-clothes as will protect all parts of the surface, notwithstanding the automatic and instinctive movements which take place during sleep. All this is still more necessary for children than for adults. In winter, sleeping cold may bring on a catarrh, sick headache, or an attack of rheumatism; in summer, may be the exciting cause of cholera morbus, diarrhea, or dysentery; which often commence in the latter part of the night, as did epidemic cholera, and for the same reason. All our physicians are familiar with the attacks of cholera infantum, which occur at the same period of the night; and I have often seen croup produced in June and

July, from the same exposure, when children who are more carefully lodged, scarcely ever contract it.

Lodging rooms should, throughout the whole year, be thoroughly aired before their inmates retire to them. If a current of wind can be made to blow through them, so much the better; but, in summer or autumn, it is right to let down the sash, or otherwise close up the windows, before we go to sleep. Two effects result from this: *first*, the exclusion of malaria, or the poison which produces autumnal fever; *second*, the exclusion of moisture, which, in the latter part of the night, often chills the body. This rule is especially necessary in the south, and along our great water-courses, where bad air and fogs so much abound. In very dry localities, and far in the north, it is less required.

SECTION IV.

HABITATIONS.

A vast majority of the inhabitants of the Valley live in wooden houses, which, even in most of our towns and cities, predominate over those of brick and stone. In the south, these houses are very commonly protected from the action of the summer sun, by porches and verandahs; while the winters are so mild that the inmates do not suffer. In the north, thin walls are an inadequate protection from the severe cold of January; and, in the absence of verandahs, from the burning heats of July. In the spring of the year, walls of brick or stone are often covered with condensed vapor; the rooms have become filled with warm air from without, which seems dry, because it contains no more vapor than it can keep in solution; but when it comes in contact with the cold walls, its temperature is reduced to the dew point; and, with the same *absolute* quantity of water, it becomes a moist air. The proper corrective is a fire, which restores the dryness, by increasing the capacity of the air for moisture. An objection to wooden dwellings is the rotting of their foundations, when, as is too often the case, they are built without an adequate under-pinning of stone. When this decay commences, the family, by night and day, breathe whatever gases or malaria may be generated. In some of the villages along our alluvial rivers, which occasionally overflow their banks, all the sills and sleepers of the houses, although so recently built, are already in a state of decay. This is especially the case in the south, where heat and moisture abound, and most of the timber used is of a soft and perishable kind. Another defect is the absence of cellars, which are seldom met with in the country, except under the best houses; and are omitted in building the small and temporary houses, which make up the greater number in our towns and cities. Even when cellars are dug, there is a neglect of the means of ventilating and drying them. All such foundations are apt to become filthy; and perpetual decay and decomposition go forward throughout the summer, even when the atmosphere is dry, thus generating a foul air, while the lower stories, or ground floors, are often rendered unhealthy by their dampness. A further defect, is the want of the means of airing the different apartments, especially those occupied as lodging rooms. A single window, with a door opening into a narrow entry — itself, perhaps, not admitting of sufficient ventilation — necessarily gives an impure atmosphere. Its inmates, from custom, may not detect the foul air; but the senses of a stranger instantly feel its impress; and every physician knows, that its chronic action on the constitution is bad. In the newly-settled parts of the country, this fault in building is carried to its greatest hight. The log cabin, resting directly on the ground, and made tight by daubing, generally has but one small window, sometimes none; and yet all the family live and lodge in it. Of course, throughout the winter, in the colder parts of the Valley, there is no ventilation, except of the space, between the door and fireplace. In better and larger houses, having halls, and several rooms, there is still another defect, which is, that no provision is made, in most of them, for warming the apartments that are not in constant use; and yet the inmates, even small children, with clothing adapted to those which are properly heated, wander through the whole, and often sustain injury. This is particularly prejudicial to small children, inclined to croup or scrofula, and to girls and young women, predisposed to consumption. The plan of warming large houses with heated air, recently introduced into some of our larger towns, is well calculated to remove this objection; but care should be taken, to guard against the dryness of the currents which the furnace sends up; otherwise discomfort, and even injury to health, may result. Hitherto our houses, especially in the country — where the practice is likely to be permanent — have been warmed with wood fires, in open chimneys: in the cities, close stoves are coming into use; and, near all the larger rivers, mineral coal is superseding wood. This kind of fuel has the advantage of maintaining a more equable temperature; but it throws out exhalations, which sometimes affect the head and lungs. What maladies may cease or be produced by the increasing stone-coal smoke of our larger, and especially our manufacturing towns, remains yet to be ascertained. Very lately the "air-tight" stove has made its way among us. In this we have the slow combustion of wood. While admirably calculated to maintain a uniform temperature, it presents two objections: *first,* it is unfavorable to a change of air; *second,* it renders the air too dry. The former is not easily remedied, because of the small and feeble current created by such slow combustion; and may require openings near the ceiling of the room, for the escape of the long-retained and rarified atmosphere, while other apertures near the floor, allow a corresponding supply to enter. The latter defect may be supplied by evaporating pans, which should always be broad and shallow, and not made of metal, nor of earthenware enameled with lead, as a decomposition of the water, by the oxydation of the metal, will liberate hydrogen gas, which, in passing off, may dissolve a portion of the metal, and thus vitiate the atmosphere of the room. Finally, the practice of occasionally warming chambers with pans of burning charcoal, is more common than is generally supposed; and every now and then, occasions death, by the liberation of carbonic oxide, or carbonic acid.

In every country, the *aspect* of a house deserves attention, and should be determined by a reference to the sun and winds. As far as possible, they should shine and blow upon it. In the Valley of the Mississippi, this general union is quite practicable; for, as we have seen, its prevailing winds are from southern points between south-east and south-west. If, then, a dwelling have its front to the south — as is generally the case in the Valley — it will be better lighted and ventilated, than if its end should be in that direction.

SECTION V.

SHADE-TREES.

Referring to health, how near should shade-trees be planted to a dwelling? Their effect, when so near as to overshadow the roof and walls, or the latter only, is no doubt to keep them cool; but they increase the dampness, by preventing the drying effect of the sun, after rains and heavy dews; and in the south, its most observing physicians and planters, are opposed to them, and prefer the verandah; which, I have no doubt, is a correct decision. It is, however, a great advantage to have trees near a house, so that they may shade the ground around it, and thus prevent the reflection and radiation of heat against its walls. On the northern side, they may be planted nearer than on the southern, as they cannot there overshadow the building. Trees, in the neighborhood of a dwelling, when not too near, not only do good in the manner just pointed out, but they protect the family, when they go out for recreation, or the ordinary business of the house; and every one must regret their wanton destruction around most of the country houses of the Valley. With the motives for their preservation, which good taste and the love of beautiful scenery would suggest, this work has no concern; but I find enough, of a purely hygienic kind, to justify a protest against the destruction of what nature, in her wise economy, has provided, to shield the earth and its inhabitants, its tender grass and delicate flowers, from the scorching rays of a summer sun.

Shade-trees should be cultivated in our towns and cities more extensively than they now are; but those which grow to a great hight, should not be chosen, because they render the walls and roofs damp. The object is, to shade the side-walks. Very broad streets or avenues should have rows of larger trees in their centers; for, at such a distance, they do not produce the injury just mentioned. while they keep down the heat of the surface, diminish radiation, and protect those who are passing. The towns of the south are generally well shaded, either with sheds and awnings, or with trees. The Pride of China (*Melia azedarach*) is the favorite, up to the latitude of thirty-three degrees, above which it does not bear the colder winters; then the resort is to the white-flowering locust (*Robinia pseuda-cacia*), with which, in higher latitudes, are blended the water maple (*Acer rubrum*), white elm (*Ulmus pendula*), catalpa (*Bignonia catalpa*), and sycamore (*Platanus occidentalis*), all of which grow too large for narrow streets. But within the last few years, the ailanthus, a foreign tree, has been introduced, and become a general favorite.

The planting and cultivation of trees, on the public squares of our cities, has not received the careful attention which their value demands. They maintain a cool place, to which resort may be had, by those who suffer from excessive heat, either in the streets, or in badly-constructed houses; and should be regarded as among the means of health and comfort for the people of every city.

To conclude, trees should be left standing between ponds or marshes and the family residence. There are many evidences that they exert a protecting summer and autumnal influence; especially when the source of disease is to the south or west of the town or dwelling.

CHAPTER IV.

OCCUPATIONS, PURSUITS, EXERCISE, AND RECREATION.

SECTION I.

AGRICULTURAL LABORS.

I. In the non-slaveholding colonies and states, that is, in Canada, western New York, Michigan, Wisconsin, Minisota, Iowa, Illinois, Indiana, Ohio, and western Pennsylvania, including the northern half of the population of the Valley, the prevailing occupation of the male sex, is miscellaneous agriculture, or farming. Most of their time is, therefore, spent in the open air; where they are exposed, more or less, to rain, morning dews, and the noonday suns; while their joints and muscles are heavily taxed, to the bad end of breaking down the health and strength of some; and the good end of giving great firmness and endurance to others.

In these labors, boys often begin to participate, as early as the age of seven or eight years; but girls and women, except among the immigrants from Germany, are seldom seen as laborers on the farm.

II. In the slave states, from the Appalachian Mountains to the Rio del Norte, there are, in reference to agricultural labor, two classes of white men:

First. Those who own a sufficient number of slaves to perform the required work of the plantation, as it is there called; and, therefore, do not labor with their own hands, but lead lives of superintendence, recreation, or idleness; spending, it is true, much of their time in the open air, but often without adequate provision against all its inclemencies; and without taking systematic exercise, for the sake of its hygienic effects. The further we go south, the greater is the proportional number of this class. *Second.* Those who either own no slaves, or so few, as to be under the necessity of participating in the labors of the field. No portion of the slaveholding states is without this class; but they are most numerous in western Virginia, east Tennessee, Kentucky, and Missouri; that is, above the cotton zone, in the latitudes which produce wheat, hemp, tobacco, horned cattle, horses, and sheep. The hardest and heaviest labors of this class, consists in cutting down the forests, and opening the farm. In the south they do not work much among sugar and cotton; but in miscellaneous agriculture — they are farmers, not planters, in the discriminating vocabulary of the country. It was formerly believed, that white men could not bear the summer heat of the field, below the thirty-third degree of latitude; but this opinion is not, at present, strenuously maintained by any one. On the contrary, it seems probable, that those men, who, in the south, work regularly in the field, enjoy better health, and live to a greater age than those who lead lives of idleness, with its sinister accompaniments.

It cannot be doubted, that agricultural labor is favorable to health and long life; notwithstanding its fatigues and exposures. Among the diseases to which it gives birth, or generates a predisposition, are rheumatism of the joints, lumbago, sciatica, bronchitis, pleurisy, pneumonia and acute fevers; the fruits of violent muscular effort, or great exposure to foul weather. Dyspepsia is not unknown among this class, but occurs from other causes, and in spite of the salutary influences of agricultural life. Nor is consumption uncommon; though, apart from hereditary predisposition, it does not often occur; and a life of agricultural labor is, perhaps, one of the best means for correcting such a predisposition.

As autumnal fever is a rural disease, those who follow agricultural occupations are, of course, among its most frequent victims.

SECTION II.

COMMERCIAL PURSUITS.

I. Under this head, I propose to treat of those who are engaged chiefly in water transportation. It is impossible to estimate their number. It probably exceeds one hundred thousand, and is every day increasing. The larger part are men, before middle life; a great number are boys, and a few, perhaps two per cent., are women. On and around the Gulf of Mexico, the labors of this class continue throughout the year; but further north there are long periods of suspension. On the lakes, navigation is interrupted through four of the cold months; and, for as many of the hot, but few watermen are required to descend the Mississippi to New Orleans. There are, in the Valley, four different provinces of commercial operation — the Gulf, the rivers, the lakes, and the prairies.

II. LIFE UPON THE GULF. — New Orleans is the emporium of the commercial marine, of the Gulf of Mexico. Of the other ports, the chief are Chagres, Vera Cruz, Havana, Tampico, Galveston, Pensacola, and Mobile. The voyages between these ports, or between any one of them and New Orleans, are never of such duration as to generate any form of disease peculiar to the sea. They are made in steamboats, and schooners, or brigs. In whatever craft, the sailors and operatives lead exposed lives, while they move in an atmosphere, the mean annual temperature of which varies, in different latitudes, from seventy to eighty degrees of Fahrnenheit; while it is nearly saturated with vapor. Their exposure to sudden showers is frequent—to that of a sun of intense power, habitual, for at least ten months out of twelve; at night they often lie in the open air; lastly, in certain seasons of the year, they are subjected to the chilling influence of the *Northers*. Most of them use ardent spirits daily; and, while in port, where they spend much of their time, many of them dip into dissipation. In addition to this class of seamen, there are the sailors and marines of the United States' Navy, who cruize in the Gulf, and undergo the same exposures, but are more restricted in the use of ardent spirits. A large proportion of all the seamen of the Gulf, are natives of more northern latitudes. In estimating the effects of the life they lead, upon their health and constitution, we must deduct the effects of intemperance, with its exposures, while they are in port; and, also, the action on their systems of the deleterious atmosphere of commercial towns, in hot climates; and, having done so, we may say, that they are liable to diarrhœa, cholera morbus, dysentery, hepatitis, and *coup de soleil*, in summer; and to rheumatism and pneumonia in winter. While at sea, as on a schooner voyage, from Vera Cruz or Havana to New Orleans, they are often invaded by yellow fever; and the same disease sometimes breaks out in our national vessels, when they have not lately touched at any port, Such, however, is but seldom the case with autumnal intermittents and remittents; the former of which sometimes cease spontaneously during a protracted voyage.

III. LIFE UPON OUR RIVERS. — 1. In the latter part of the last century, and for the first fifteen or twenty years of the present, the commerce of the Interior Valley was carried on in flat boats, which floated with the current, and in keel boats, and barges, which were, by oars, setting poles, and cordells, propelled against it. Flat boats still continue in use, but the others are no longer employed. The principal voyages were from the Ohio River to New Orleans; and the watermen who performed them, constituted a peculiar class: *First*. They were, for a long period, exposed to a river atmosphere. *Second*. Their exposure to the weather was incessant. *Third*. Their diet consisted chiefly of bread and meat. *Fourth.* They drank whisky to excess. *Fifth.* Those who returned by the river, were compelled to labor in the most toilsome manner, and were often in the water. *Sixth.* Those who traveled back by land, performed a journey of a thousand miles, on horseback or on foot, encamping at night in the open air.

In this occupation many died of fevers, contracted from lying through the night at the river banks, or at New Orleans; and rheumatism or pulmonary diseases were the lot of others; but the majority were strong and hardy — none being more so, than those who performed the long overland journey from New Orleans, to the middle portion of the Ohio River, on foot. Since the general introduction of steamboats, the flat boat hands no longer return by land; but on the lower decks of those boats, where many of them yield to dissipation, and the mortality is, I presume, quite as great as among those of former times.

2. The number of men and boys employed in navigating our numerous steamboats, amounts to many thousands. The most exposed and reckless are the firemen and deckhands. The diet of the operatives is chiefly bread and meat, with coffee in the morning. Their labors are heavy, and require to be performed by night, not less than day. They are much exposed to all inclemencies of weather, and are often in the water. The firemen pass much of their time in a heat of one hundred and twenty degrees, and some of it, in a heat of one hundred and fifty degrees, Fahrenheit, as I have ascertained by the thermometer, when their pulses rise, in frequency, to one hundred and thirty or one hundred and forty in a minute. Both classes are in the habit of throwing themselves on the bow of the boat, where they are exposed to a wind equal to the velocity of the boat. To counteract the effects of these various exposures and irregularities, many of them drink freely of ardent spirits; and the firemen, especially, regard such drinks as necessary to the maintenance of that perspiration, which cools their bodies after approaching the furnaces, which they feed with fuel. The experience of the most observing commanders is, however, that these and every other class of steamboat operatives, enjoy better health, and have greater strength when they refrain from drinking. As to the diseases to which they are most liable, if I may judge from what I have seen in the Louisville Marine Hospital, and the Commercial Hospital of Ohio, at Cincinnati, they are chiefly diarrhœa, and intermittent fever, with its *sequelæ*, disordered spleen, and dropsy. Rheumatism and pulmonary inflammation are, however, not uncommon. Finally, a large number are suddenly destroyed by mechanical accidents, drowning, or scalding; and a still larger number are driven from employment, to die a lingering death from the diseases produced by intemperance and river exposure.

The steamboat river-pilots have a peculiar duty to perform, which might be expected to affect their eyes unfavorably. For twelve hours out of every twenty-four, they are kept in a state of active vision; at night straining their eyes to see objects by a dim light, or through the fog — in the day, having them directed upon a watery surface, which often reflects an intense light. Ophthalmia and amaurosis might be supposed to result from such a life; but I am not aware that they have often been produced.

IV. LIFE ON THE NORTHERN LAKES. — Our fresh-water sailors pass their active lives in a mean temperature of about forty-five degrees, instead of seventy-five degrees like those of the Gulf of Mexico. Their voyages are made in schooners, steamboats, and propellers. The number of operatives is large — quite equal, perhaps, to the number employed upon the Gulf, if we except those coming in European vessels. The lake voyages are generally short and, therefore, much of the time of the watermen is passed in port. They expose themselves less than the sailors of the Gulf, and are more temperate in alcoholic indulgences. Most of these moreover, are natives of the climates in which they labor. Thus the causes of disease to which they are exposed are fewer, and they enjoy better health than their brethren of the Gulf of Mexico. The bowel complaints and fevers of the Gulf, especially, are much rarer here; but intermittents sometimes attack those who frequent the southern shores of Lake Erie; and all are liable to pulmonary inflammation and rheumatism.

V. LIFE UPON OUR CANALS. — It is a popular opinion that the excavation of canals, in summer and autumn, is an unhealthy employment; and the history of that which leaves the west end of Lake Erie, at Maumee bay, for the Ohio River; that of the Erie and Beaver canal, in western Pennsylvania, and that of the new canal, connecting Lake Ponchartrain with New Orleans, seem to give support to this opinion. Indeed, as canals are generally excavated through soils — alluvial or diluvial — which abound in undecomposed organic matters, the first exposure of them to the sun and rains would seem likely to favor the production of a deleterious atmosphere. Nevertheless, we must be on our guard against error in this conclusion; for, *First,* Canals are generally dug through low and flat lands, which are known to be productive of autumnal fever; thus there was a marsh along the side of the Maumee Canal; and that of New Orleans, was dug through a cypress swamp. *Second.* The operatives are unacclimated Irishmen and Germans, chiefly the former; who lodge in temporary shanties, often directly on the ground, and indulge largely in whisky-drinking. Thus, if they had spent the same seasons of the year, under the same circumstances, without stirring up the surface of the earth, they *might* have suffered in an equal degree. But I need not dwell on this point, as it must come up under future heads.

The *effects* of canals on the health of the inhabitants living near them, have, in several instances been pernicious. A great increase of autumnal fever followed on the completion of the Erie and Beaver Canal just mentioned; especially about the summit level, between Lake Erie and the Ohio River, where a basin to afford water was contracted, by throwing dams across the outlets of Conneaut Lake. Some of the surrounding neighborhoods, previously exempt from any fatal prevalence of autumnal fever, were, as we have already seen, in treating of the topography of that region, almost depopulated. It is a common practice to draw off the water from our canals, in the month of June, after the spring navigation is over; and the exposure of their mud bottoms would seem likely to generate fevers; yet I have not been able to learn that such has been the effect, at least, to any great extent. A large number of boats run on our canals, and as they continue in motion all night, in summer and autumn, as well as in other seasons, through regions which frequently abound in marshes, it might be expected that the operatives would be often down with fevers; still, the result of my inquiries is, that they are less liable to those diseases, than the people who live on the banks of these thoroughfares.

VI. Life of the Voyageurs. — *Lastly.* The Voyageurs, who ascend our long rivers to the Rocky Mountains, and pass over the Valley, from Lake Superior to Hudson Bay, and the lakes and rivers to its west, merit a more extended notice than either of the classes enumerated.*

This class or *caste* of watermen. consisting chiefly of French, and their descendants, began to form soon after that people came upon the continent. From the earliest period of settlement in Canada and Louisiana, the attention of the immigrants was turned to the Interior of the Valley, which they undertook to traverse by its vast lakes and rivers, in canoes, and skiffs at length called Mackinac boats; which, of course, were worked by hand, with oars or paddles, and often propelled against strong and unrelaxing currents. After the conquest of Canada, in 1763, immigrants from Great Britain began to mingle with the Canadian Voyageurs; and, on the cession of Louisiana, forty years afterward, a new addition was made from the United States; but the greatest reinforcements have been their own offspring, by Indian women; which, half-breeds or mestizoes, make, according to some computations, nearly one-third of the whole. Many of these people spent the whole period of their active lives in this service; to which they became strongly attached. The romantic scenery of the lakes and rivers, and the picturesque appearance of savages, and wild animals, roaming through deep solitudes, invested this new branch of commerce with a charm, which fascinated the Canadian imagination, and drew thousands into this peculiar service. For a long time, their voyages were performed in canoes and pirogues, of birch bark. Gradually the adventurers became familiar with the western shores of Lake Superior, ascended the river St. Louis; and, traversing a portage, reached the highest waters of the Mississippi, or spread themselves over the distant north-west. Others took their departure from Green Bay, and descending the Wisconsin, floated out upon the Mississippi, in a lower latitude; while others still, departing from the southern end of Lake Michigan, passed down the Illinois, and ascended the Missouri. Their evenings were spent in smoking, garrulous talk, and singing. They lodged under tents, or beneath their inverted canoes. Many of them spent the winter in those desolate regions, unwilling to return without full cargoes of

* In speaking of them, I do not refer to printed authorities — having had ample opportunities of conversing with gentlemen who have been familiar with their habits, of whom I may mention Mr. Samuel Abbott and Mr. William Johnson, of Mackinac, Mr. Robert Stewart, of Detroit, and Colonel Mitchell, of St. Louis. I have, also, had some personal opportunities of seeing them.

those furs, which were the objects they sought. At all times, while sitting in their canoes, they were exposed to every inclemency of weather, and were often under the necessity of wading in shallow water. They mingled much with the native tribes, and adopted many of their customs; intermarried with them, and reared up a race of half-breeds, to become, as already stated, their associates and successors.

In the use of alcoholic drinks they were, of necessity, temperate, except when in port. Tobacco they never dispensed with. Their diet consisted essentially of maize or Indian corn; the variety called white flint being preferred. It was boiled in a ley of wood ashes until the outer integument could be rubbed off, and then put in sacks. A quart of this corn, with two ounces of tallow, or hard fat, boiled through the night, constituted the ration of a *Voyageur* for the ensuing day.

Free from care, and alive to the exciting novelties through which they passed, no despondency came over them, and the *gaieté du cœur*, and vivacity of the French, never shone with finer radiance, than on the shores of Lake Huron, or the rivers which meander through the boundless prairies between Lake Superior, Hudson Bay, and the Rocky Mountains.

I have spoken of the *Voyageurs* in the past tense; but the race is not extinct, though it has lost much of its original, racy character. In latter times, steamboats and schooners, by ascending our great rivers, or traversing Lake Superior, tend to keep the *Voyageurs* in the distant wilderness, and also to limit their number; so. that they are no longer constant visitors in St. Louis, Mackinac, Detroit, Kingston, and Montreal, as in past times.

The *Voyageurs* are generally below the ordinary Anglo-American standard in hight; but are muscular and very strong, from being compelled to carry heavy burdens, including their canoes, around the shoals and rapids of the rivers on which they run. The pack of furs, weighing eighty pounds, rests upon the upper part of the back, and a broad strap, passing across the forehead, keeps it in its place. At the portages, as that around the falls of the River St. Louis, west of Lake Superior, the common burden for a man is two packs, equal to one hundred and sixty pounds, to be carried a mile; but, Mr. William Johnson, of Mackinac, assured me, that he saw a half-breed, Skauret (for his name deserves to be recorded), carry four—or three hundred and twenty pounds, through that distance without laying them down. The *Voyageurs* are not only strong, but healthy. Those on the Missouri River sometimes experience ague and fever, from which those further north are exempt. They occasionally have rheumatism. Mr. Samuel Abbott, in a residence of nearly twenty years at Mackinac, had seen but two cases of consumption among the many who had made that island their headquarters; and whether they were examples of true phthisis, or only chronic bronchitis, I could not learn. Mr. Johnson, who had spent a year among them, observed that under all the exposures of their voyage from Lake Superior to Leech Lake, they were healthy; but when they came to winter in huts, and eat fresh meat, they were subject to catarrhal affections.

Since the cession of Louisiana, in 1803, many American young men have become hunters and trappers, in the region between St. Louis and the sources of the Missouri and Yellow Stone, and have been mingled with the *Voyageurs*, or, of themselves, penetrate to the skirts of the Rocky Mountains, where they sojourn a great part of their itme. The flesh of the buffalo makes a considerable part of their food.

VII. Santa Fe Traders. — We come, in the last place, to a class of traders who transport their goods entirely by land. They leave the Missouri River, not far from the mouth of the Kansas, and cross the prairies to Santa Fe and Paso del Norte, thence to Chihuahua, and in the northern part of Mexico, a distance to the first of seven hundred and seventy miles. The transportation is in wagons drawn by oxen, and on mules. The time occupied in going out, is generally from two to three months — in returning, less. The best seasons for these trips are May and June, and August and September. Some of the caravans have with them two hundred men. Their diet is generally composed of cakes of flour, bacon, the flesh of the bison, and coffee; to which beans and crackers are sometimes added. They often suffer for want of water. At night they lodge in or beneath their wagons, or in tents; but after passing the one hundred and first or second degree of west latitude, there is so little dew, that no shelter is necessary at night, except from rain, which, however, does not fall very often. The Santa Fe traders generally enjoy excellent health. Although their trips are often made at seasons of the year, when various parts of the Valley are scourged with autumnal fever, they are scarcely ever attacked; an exemption, however, which connects itself less with their occupation, than the peculiar region of country through which it is carried on.*

SECTION III.

MINING AND SMELTING.

I. Coal Mining. — As our beds of coal lie horizontally, and the more superficial are not yet exhausted, our miners are not compelled to descend deep into the earth. It sometimes happen that they tunnel a hill, and by bursting out on the opposite side from that at which they entered, as at Pomeroy, on the Ohio River, establish a current of air through the drift, which carries off both vapor and the gases which may be developed. When such thorough perforation is not practicable, the drift or horizontal shaft, has this advantage over the vertical, that water does not accumulate in the mine, to increase the humid atmosphere; and by sinking tunnels or perpendicular

* Elisha Stanley, Esq., Booneville, Missouri. Gregg's Commerce of the Prairies.

shafts down to the horizontal, at points distant from the outer opening, and maintaining fire in them, artificial ventilation is effected. Notwithstanding these advantages, I found, when exploring the Pomeroy mines that, in the side drifts, the candle sometimes burned with a dim light, indicative, perhaps, of the presence of carbonic acid gas. I do not know that an explosion has as yet occurred in our coaleries. The temperature in which the miners work is, of course, that of the earth, and varies but little from summer to winter. Most of our mines lie between 37° and 42° of N. Lat., and consequently the heat of the earth ranges from sixty degrees to fifty degrees, of Fahrenheit's thermometer. That of the Pomeroy mines, in N. Lat. 39 °5′, I found, in the month of July, to be, in different parts, from fifty-eight to sixty degrees.

The miners at Pomeroy, as in our coal drifts generally, work with picks, and are often compelled to assume and maintain themselves in very unnatural postures. Sometimes they stand erect, then stoop, then sit, then recline on the left shoulder. From the degree in which their faces become soiled, it is obvious that they detach, and must inhale, a great deal of coal dust. They wear woolen shirts. Their dinners, eaten in the mines, consist of bread and meat. They breakfast, sup, and lodge at home. In the morning they use coffee, and most of them drink beer or whisky. They are chiefly Welsh, English, and German immigrants.

Now, what is the effect on health of this kind of life? To the eye, these men appear as sound and well-developed as other laborers. They informed me, that they sweat a great deal, which I suppose is not the case; but, from the dampness of the air in which they work, the insensible perspiration does not escape freely, but suffers condensation on the skin. Their digestion is good, but they are prone to constipation and hæmorrhoidal affections. Dr. Thomas, who had, when I visited this coalery, in 1847, been the physician of many of the operatives for three years, told me that he saw a case of constipation, which lasted for two weeks. The abdomen of the patient was hard and swollen, though not painful; but after the operation of cathartic medicines, considerable pain was developed. In another case, after the constipation had lasted a week, the patient died, and a *post mortem* examination disclosed a great accumulation in the cœcum, colon, and rectum, of dark brown, and dry scybalous matter. The same physician informed me that he had seen among them several cases of orchitis, which he ascribed to their reclining, while at work, on the left side. While mingling with them I heard no one cough; and the oldest miners, together with one of the highly intelligent and reliable proprietors, V. B. Horton, Esq., assured me, that consumption is almost unknown. Rheumatism and lumbago are also rare; and they are less liable to autumnal fever, than those who, in the same locality, work in the open air. The miners hold the opinion, that their employment is a healthy one, and yet they say that but few who follow it attain to old age.

At the Kenawha Salines, the coal diggers, who are chiefly negroes, often become affected with coughs; and Dr. Street has seen them expectorate a blue mucus.

At Pittsburgh, where coal has been dug for a longer period than in any other locality of the Interior Valley, the operatives, as Dr. Bruce informed me, are as healthy as those who labor above ground; and in ten years he had not known a case of consumption among them.

II. Iron Mining and Smelting. — Much of our iron ore is dug up in the manner that stone is quarried, the operatives working in the open air. In some places drifts or horizontal shafts are made beneath the surface, and the process is like that of coal mining. In 1847, I visited the *Fair Chance Iron Works* of F. H. Oliphant, Esq., six miles south of Uniontown, Pennsylvania, one of the oldest establishments in the Valley, at which about one hundred and twenty operatives are employed. The men who work in the horizontal drifts, some of which are four hundred yards in length, are even healthier, as that respectable gentleman informed me, than the men who labor in smelting and forging; those who work in the latter branches, are exposed much of the time to an atmosphere varying from ninety-five degrees to one hundred and three degrees, and sweat profusely; which, perhaps, counteracts the effects of the ardent spirits, which about a fifth of them drink freely. Their appearance confirmed the declaration of Mr. Oliphant, that they, not less than those who had preceded them, are a healthy set of men.

The ore is roasted by being thrown into the top of a chimney with charcoal. When sufficiently heated, it is broken with a hammer. Fumes, which are sulphurous to the smell, and may, perhaps, be slightly impregnated with arsenic, issue from the chimney; and the man whom I found working over it, informed me that he sometimes felt a sense of suffocation, and had brief umbilical pain, without constipation. He added that he had declined in flesh from the time he entered on that occupation. I have not enjoyed the opportunity of making inquiries at any other iron works.

III. Lead Mining and Smelting. — These are chiefly carried on in the eastern edge of Missouri and Iowa, the north-west corner of Illinois, and the south-west of Wisconsin Territory. The number of miners is unknown. They are chiefly English and Anglo-Americans. Their manner of life is simple. Bread and meat, with a moderate supply of milk and vegetables, constitute their food. Much of the ore is quarried near the surface, especially in Missouri, and but few shafts have been sunk to any great depth Some of them strike upon veins of water, which require to be pumped out; but, in general, the miners do not spend a great deal of time in deep, dark, and humid caverns. They who work on the surface of the ground, are often exposed to inclemencies of weather. Most of them drink whisky, though the custom is on the wane.

In a visit to the mining districts of Wisconsin and Illinois, I found the general appearance of the miners healthy. From topographical circumstances, they are not very liable to autumnal fever. Governor Dodge, who had resided among them for several years, thought rheumatism their most prevalent disease, and next to it, pleurisy. Others had observed a prevalence of chronic hepatitis among the English miners, the apparent effect of their greater drinking for the first years after their arrival. They do not seem to be effected in any manner by handling the ore.

Several years ago, when smelting was performed in rude log furnaces, colic was common; but, since the introduction of those of a better construction, which carry off the fumes, it has become rare. In visiting one of the best, I perceived a peculiar taste in the air; but its proprietor assured me that none of his operatives ever experience attacks of colic or paralysis. Those who own these establishments encourage ablution before eating, and the use of oleaginous diet. It is a popular opinion that the man who can eat the greatest quantity of fat meat, is safest from the diseases produced by lead. There is, no doubt, a portion of arsenic volatilized along with the carbonate of lead, in these establishments.

SECTION IV.

SALT MAKING.

1. At Syracuse.—I have already (*page* 404) spoken of the degree in which autumnal fever prevails at this place. It remains to say something of other diseases. The water is evaporated, both by solar heat and culinary fire, and the atmosphere is so impregnated with saline vapor, that all kinds of polished cutlery rust with great rapidity.

Dr. Hoyt, who had resided in Syracuse for fifteen years, when I was there in 1847, together with Dr. Daniels, who had lived thirty-two years, and Dr. Lovejoy, who had practiced ten years in the adjoining village of Salina, affirmed, with great confidence, that the venous blood of the salt boilers, is nearly as florid as the blood of the arteries; and that the complexion of these operatives are ruddier than those of the surrounding population. Dr. Trowbridge, on the other hand, after a residence of four years, had not seen those appearances. Dr. Daniels and Dr. Lovejoy declared that phthisis, as originating among the kettle tenders, was almost unknown; that patients, in the incipient stages of that disease, had been relieved by visiting the evaporating houses and inhaling the warm saline vapor; and that hæmoptysis was often cured by it. These observations were in accordance with those of Mr. Woodruff, the inspector of salt, who had resided on the spot where Salina is now built, for forty-five years; who, moreover, referred to many cures of what he called consumption; but the experience of Dr. Trowbridge was adverse to these conclusions. Scrofula, according to Dr. Hoyt and Dr. Lovejoy, is a rare disease in this locality, and neither of them had seen a case among the salt boilers. Of maladies apparently produced by the saline atmosphere, I could learn but little. Dr. Lovejoy thought the kettle tenders more subject to diarrhœa, than other persons. Having had some reason to believe that fungus hæmatodes is more common in saline atmospheres, than elsewhere, my inquiries were turned to that point while in conversation with Dr. Hoyt, who told me that, in fifteen years, he had seen twelve cases; which, supposing his diagnosis to be correct, was a very remarkable number.

II. IN THE KENAWHA VALLEY. — The condition of the atmosphere, at these salt works, and its influence on autumnal fever, has been already given at *page* 264. The furnaces are not inclosed in houses, as at the Onondaga salines, but under sheds. A large proportion of the kettle tenders and other operatives are negroes. Their diet is chiefly corn bread and bacon. The observations of Dr. Patrick, Dr. Street, and Dr. Putney, who have long resided here, are, that its saline and carbonaceous atmosphere, neither presents nor occasions any disease in the general population.

When men first go at this business, they are apt to be affected with diarrhœa; and, in the opinion of Dr. Putney, bowel complaints are more common in the Valley generally, than elsewhere. The physicians whom I have named, do not believe that the negroes of the furnaces, although from the absence of houses they are exposed to greater vicissitudes of temperature, are more subject to tubercular cachexy than others; perhaps even less.

Dr. Putney saw a negro, who suffered from asthmatic breathing in the coal drifts, cured by being made a kettle tender. Dr. Street has understood, that the itch is cured by the same employment. The various eruptive fevers and pertussis, prevail here as elsewhere; and the Epidemic Cholera proved fatal to many, in its former as well as its latter invasion. Having had several patients with fungus hæmotodes from this valley, my inquiries, as at Salina, were directed upon that malady, but I did not learn that it is especially frequent. Scrofula is here thought to be about as common as over the country generally. Scurvy and hæmorrhages are not frequent; and no one seems to have noticed the florid color of the venous blood, said to be common among the kettle tenders at Syracuse.

SECTION V.

MECHANICAL AND CHEMICAL ARTS AND MANUFACTURES.

I. In many parts of the Interior Valley, most of these are unknown; and the introduction of them into other parts has been too recent to admit of a comparative estimate of their influence on health. I have not, moreover, found time for those minute and careful inquiries, which are necessary to the collection of reliable facts. What I have amassed, will appear when treating of the causes of different forms of disease. I will here limit myself to a few general observations.

II. Many handicraft employments confine those who practice them to the house; and, not being laborious, do not afford sufficient exercise, or they call into action particular portions of the muscular system only. Two sinister effects almost invariably follow on this kind of life: *First.* The individual does not breathe enough to depurate his blood of its carbonaceous matter, and supply his system with oxygen. *Second.* He becomes costive, and his liver and stomach fall into a state of inactivity, accompanied with dyspepsia, hæmorrhoids, palpitations of the heart, and sick headache; while those who inherit a predisposition to consumption, are apt to experience a fatal development of that disease. All this is especially true of young women who, as seamstresses, sit ten or twelve hours out of the twenty-four, and in the remainder take but little active exercise. In connection with this I may remark, that several occupations of both sexes, keep the trunk of the body in some constrained posture, unfavorable to the organs of the thorax or abdomen.

III. Other occupations are carried on where the operatives are compelled to breathe an atmosphere impregnated with mechanical impurities, such as cotton, hemp, flour, and stone-dust, whereby the lungs are irritated, and chronic bronchitis is established, or the deposition of tubercular matter promoted.

IV. Those who work in lead, copper, and type-metal, are liable to have their nervous and muscular systems empoisoned and paralyzed, by breathing an atmosphere impregnated with those metals or their oxides.

V. In the manufacture of sulphuric and nitric acids, of lucifer matches, both sulphurous and phosporous, and generally of what are called chemicals, gases are disengaged which are highly irritating to the lungs. The number and variety of these manufactures has greatly greatly increased, in certain parts of the Valley, within a few years, and may be expected, ere long to make themselves felt as etiological causes. Thus, with the multiplication of the arts of an older state of society, will come new forms of disease.

SECTION VI.

EXERCISE, RECREATION, AND AMUSEMENT.

I. If hard labor and exposure generate a few diseases, want of exercise and recreation, is the remote cause of a far greater number. There is no country where the necessity for a confined and sedentary life exists in a less degree, than in our Interior Valley; and, at the same time none, perhaps, in which, if we except the British population of Canada, the value of systematic exercise is so little appreciated. In every epoch of life, our anatomy and physiology demand exercise and recreation. In childhood and youth, they are necessary to the growth of the muscular and osseous systems, the firmness of the nervous tissue, the efficiency of the organs of sense, and the sound and healthy development of the lungs and chest. Notwithstanding these obvious truths our children, both at home and in the school or college, are allowed to grow up in bodily listlessness; and consequently, they suffer under numerous infirmities of health and frame, from which, by proper physical discipline, they would be protected. The time they do not spend in study, is spent in loitering; as though suspended mental application were equivalent to active bodily exertion, in the midst of scenes and objects fitted to act on the external senses; as though leaving the schoolroom for the paternal roof, would render free and long-continued exposure to air and light unnecessary. Docile or ambitious children, of both sexes, often study too intensely; and, at the same time, take too little exercise. This is a worse condition than that of mental and bodily idleness, or of close confinement without study. From this compound of positive and negative causes, come irritations of the brain and spinal cord, headache, epilepsy, chorea, hydrocephalus, curvatures of the spine, scrofula, dyspepsia, consumption, and death. Parents and teachers ought to know, that a child cannot, without injury to health, study a great deal; unless it be required to take much active exercise in the fresh air, and that too in all sorts of weather.

Throughout the efficient period of adult life, those who pursue sedentary employments, as students, shop-keepers, and artisans, of both sexes, take little out-door exercise. Their close confinement renders the stomach and bowels torpid, and brings on dyspepsia; softens their muscular systems, except such portions as may happen to be exercised by their business; diminishes perspiration and exhalation from the lungs, and thus renders the blood impure; finally, imparts an unhealthy sensibility to their nervous systems, giving rise to chorea, hysteria, and hypochondriasis. All this, in a less degree, may be the fate of those who, from the possession of wealth, follow no occupation, and yet take no systematic exercise. Out of such a state of the constitution grow up various diseases; some of which prove fatal, while others make the individual habitually infirm, limit his usefulness, and render the duties of his calling burdensome.

In the slaveholding states, and in our cities generally, women, who are not compelled to labor, experience many infirmities, which are the consequence of bodily indolence and inactivity; some of which, in the end, prove fatal.

To the aged, exercise is of great value; but it should be rather passive than active. They, however, who have been inured to active exertion through life, should not discontinue, but only diminish it in old age; and when they find it irksome or impracticable, should take that which is passive. Its advantages are various: *First.* It tends, in some degree, to keep off the constipation, which generally increases with age. *Second.* It contributes to retard the corpulence which so often renders old age burdensome. *Third.* It promotes a more frequent and complete evacuation of the renal secretion, and thus prevents the formation of calculi. *Fourth.* It diminishes venous plethora, and lessens the danger of apoplexy. *Fifth.* It aerates the blood, so liable to become highly carbonated and black in the aged, and thus invigorates the nervous system. *Sixth.* It excites the senses and keeps the individual in association and sympathy with surrounding nature, and thus maintains cheerfulness and serenity of mind, which react beneficially on his body.

Walking, running, athletic games, climbing, riding, and swimming, all in the open air, are proper in childhood and youth; and, instead of being discouraged, should be promoted and regulated. It is much easier, however, for parents to do the former than the latter; and they too often take the course which gives them the least trouble, apparently unconscious of the injury that may follow.

It is much to be regretted that the art of swimming is so little taught and practiced, as a part of the education of our children of both sexes. Our numerous lakes in the north, our bays, lagoons, estuaries, and crescent lakes in the south, and the rivers which intersect the interior in all directions, afford facilities of which almost our entire youthful population might avail themselves; and they would do so, if aided by those on whom they depend. Swimming exercises the muscles, the senses, the imagination, and the feelings, in a way peculiar to itself. It is valuable, moreover, to the skin, as keeping it clean, and hardening it against the effects of rain and accidental wetting. But parents do not encourage their sons to go into the water, because some get drowned. The answer to this is, that more are drowned, in the course of life, from ignorance of the art, than perish in acquiring it. And they do not teach their daughters to swim, because the requisite arrangements cannot be made without some trouble and expense; which is the true reason why so little attention is paid to exercise and physical education of every kind. But the physiologist and physician will insist, that the formation of a good constitution in his child, is the first duty of every parent; and, therefore, that less should be expended on other things, and more on physical discipline, without which, solidity and vigor of frame with sound health, cannot be attained.

It is not uncommon to meet with parents who regard dancing as affording sufficient exercise, especially for their daughters. But this is a great mistake. Dancing is undoubtedly a *natural amusement;* but the instinct was not implanted in us for the purpose of prompting to that exercise, which should be the result of other motives; moreover, as a hygienic method, it is obnoxious to several strictures. *First.* It partakes too largely of the character of an amusement to admit of sufficient muscular exertion, without generating a love of pleasure; which, once established, will render all exercise, not productive of immediate enjoyment, tasteless and irksome. Thus, this kind of exercise may be said to be self-limited. *Second.* Children and young persons, when prepared for dancing school or dancing parties, are generally dressed in a way that is unfavorable to the free action of their limbs; and, what is of far greater moment, of the muscles of respiration. *Third.* They are crowded into an apartment where the air is heated and impure; and, often too, at night, during the very hours when they ought, according to their physiology, to be asleep. *Fourth.* Some, who have frail and delicate nervous systems, are injured by the music so long acting upon them. *Fifth.*

They are all liable to be injured by the eating and drinking which too often prevail. Dancing, in fact, is much more a means of disciplining the muscles, than of giving them vigor. As a mode of exercise in childhood and youth, it is insufficient; and as a method of amusement, in after years, it is neglected by those who, physiologically speaking, most require it.

Walking, riding on horseback, and manual labor, are well suited to early and middle life. A daily walk of several miles, by young persons, of both sexes, who are not engaged in business, would be of inestimable value to their constitutions; yet who among us has seen it practiced? A walk of a single mile is regarded as an enterprise to be remembered with self-complacency; and if, under necessity, extended to twice that distance, a hardship to be recounted for the purpose of exciting sympathy.

Saddle exercise, especially since new modes of conveying the multitude have been introduced, is so much neglected, that many of our young men do not understand the management of a horse; while a still smaller number of young women are taught to ride, even when time and means are enjoyed without limitation. Yet nothing would contribute more to the vigorous and graceful development of their frames, than equestrian exercise.

Our students and literary men might greatly promote their health, and strength, and freshness of mind, by devoting their leisure hours to some mechanical labor, when placed under circumstances which render other modes of exercise inconvenient. Many of them are put to study, or assume it, because of their infirmities of body. To adopt such a course indicates still greater infirmity of mind. To adopt it, and then neglect corporeal exercise, is fatal; and yet such is the prevailing folly of our people, that these cases are of daily occurrence. Many attempts to establish manual labor academies and colleges, in different parts of the Valley, have been made; but all have failed, or dragged heavily along. The cause is to be found in the deeply-rooted aversion of our people to active effort, when pecuniary gain is not to be its immediate reward. A young friend of mine, in one of his college vacations, devoted himself to carpentry; and, without instruction, erected a frame tenement—he is now an able professor in one of our colleges.

Traveling is especially adapted to the aged; and no portion of the earth offers such facilities for it, as our widely-extended Interior Valley. A voyage from Pittsburgh to the Balize in cool weather, or from Louisiana to the Lakes and St. Lawrence in hot weather, or from the banks of the Ohio River to the mouth of the Yellow Stone, or the Falls of St. Anthony in May or June, would, for the aged of either sex, be a good substitute for the imaginary fountain of health and rejuvenescence, in search of which Ponce de Leon sought the shores of Florida. I have already indicated several of these routes, and many others might have been pointed out.

II. Amusement may be advantageously associated with exercise, as a means of promoting it, and indeed, giving it greater efficiency; for that which is not prompted by any immediate motive, nor accompanied with pleasurable emotion, is less beneficial to the body than that which is.

Amusements are generally sought out by the idle as a substitute for occupation, or by the dissipated as administering to their sensual existence. To both classes they are unnecessary, and serve no other purpose than to confirm them in courses of life incompatible with firm health, vigor of mind, and sound moral feeling. Properly estimated, amusements are adapted to the physiological condition of the laborious, especially those whose vocations impose much mental toil and anxiety of feeling. Under such labors, many a constitution of both body and mind, especially in our larger cities, as New Orleans, St. Louis, and Cincinnati, is prematurely worn out; simply because the irritation of the nervous system is seldom appeased by the genial influence of innocent and cheering amusements. Irascibility, corroding anxiety, and a shade of gloom and misanthropy, are the legitimate fruits of over-action of body and mind; and those feelings, reacting injuriously on both, contribute, with other causes, to generate various nervous disorders, up to insanity itself. The rivalries, cares, and misfortunes of civilized life, require to be met with recreations and amusements, to a certain extent, their true physiological antidotes. It is well known, however, that in the Valley this is not the case. Hence there is no country in which the drudgery and perplexities of business are more pernicious to the constitution. The repugnance of the more rational and moral part of the community, to any and all of our fashionable amusements, is founded on their abuses. Most of them run into some form of dissipation, and become repulsive to persons of pure moral taste; while they often prove injurious to the health and morals of those who become devoted to them. This association of sensuality and dissipation, with several amusements, keeps the whole in discredit; and repels large classes of the community from participation in any. Public balls have been abandoned by thousands who do not regard dancing as wrong, because of the dissipations connected with them; our theaters are shunned by the moral portion of the people, on account of their licentiousness and buffoonery; our nine-pin alleys are mere appendages of drinking houses; our evening parties are scenes of midnight gluttony and drinking; our musical *soirees* are of feeble and limited interest, from a prevailing want of relish for melody, and the absence of a national ballad music; we are deficient in galleries of painting, and a taste for the fine arts has not yet been generally awakened among us; our public gardens and promenades, few in number, and often in bad order, are generally but marts of intoxicating drinks; finally, to speak of the Anglo-American people of the Valley, they have but two patriotic festivals in the year; from both of which, many of the wise and temperate have been repelled, by the outbursts of vulgar dissipation which so often attend their celebration.

It results, from all that has been said, that the wearied student and care-worn business man, night after night, retire to bed without having their imaginations and feelings diverted from the pursuits of the day, by any scenes of innocent gayety; and thus their very dreams prey on their nervous systems; prevent the renovation, which sleep, preceded by appropriate amusements, would naturally produce; and the reinvigoration which is required to fit them for the labors of the succeeding day.

CONCLUSION OF BOOK I.

Our general etiology is now brought to a close. If the reader has found its perusal a work of labor, he will be prepared to estimate the amount which has been required to collect, arrange, condense, and give unity to so many diversified facts, connected with a country of such vast extent, and races of people so various. In doing this, I have introduced nothing which I did not consider necessary to a full understanding of the diseases, which are to come under our consideration; for all peculiarities of constitution, both corporeal and mental, exert a modifying influence on disease. In this country these peculiarities are not yet largely developed, but we may study their causes, and, as far as possible, infer their effects; which our distant successors will see in their full development. A synthesis of varieties and races is going on; and the result, I may here repeat, must be a new national constitution—physical and mental—of which the Anglo-Saxon, itself a compound, will be the basis and the governing element. The physicians of a future day will see, what we cannot now, a prevailing temperament, a stature, form, complexion, and physiognomy, characteristic of an indigenous, but greatly compounded race; with its own physical, intellectual, and moral constitution; its special liabilities and exemptions from disease; its national idiosyncrasies, and the required peculiarities of hygienic regimen, and therapeutic treatment. In the course of this development, what hereditary diatheses may disappear, and what new ones take their places; what new maladies may arise, or old ones cease or become greatly modified, under the joint influence of mingled blood, of climate, water, occupations, modes of living, customs, and moral, social, and political influences, cannot be specified; but a few predictions may be hazarded:

1. Autumnal fever will decrease, and typhus and typhoid fevers become more prevalent.
2. Gout will occur oftener than at present.
3. The diseases produced by the intemperate use of ardent spirits will diminish.
4. Consumption and scrofula will increase.
5. Apoplexy, palsy, and epilepsy will become more frequent.
6. Diseases of the liver will become less, and those of the mucous membrane of the bowels, more prevalent.
7. Lastly, mental alienation will be more frequent.

We are now prepared to enter on the study of particular forms of disease. In doing so I shall not adopt the classification presented in any system of nosology, nor invent a new one; and yet I hope to proceed with such a degree of method as will be found sufficient to avert confusion. The Second Book will be devoted to febrile diseases, under the five following heads: *First*. AUTUMNAL FEVER — *second*, YELLOW FEVER — *third*, TYPHOUS FEVERS — *fourth*, ERUPTIVE FEVERS — *fifth*, PHLOGISTIC FEVERS, or the PHLEGMASIÆ. The transition from general etiology, to that fever which, in its origin, has a close connection with soil and climate, is natural; and the transition from the phlegmasiæ to many other forms of disease, will be found equally natural, and hence I have placed them last, although in a system of elementary pathology, or nosology, they should stand first.

Book Second.

FEBRILE DISEASES.

PART FIRST.
AUTUMNAL FEVER.

CHAPTER I.

NOMENCLATURE, VARIETIES, AND GEOGRAPHICAL LIMITS OF AUTUMNAL FEVER, TOGETHER WITH THE TOPOGRAPHICAL AND CLIMATIC CONDITIONS UNDER WHICH IT PREVAILS.

SECTION I.

NOMENCLATURE.—VARIETY.—IDENTITY.

I. Nomenclature. — In different parts of the Interior Valley, the fevers, which we are about to study, are known under the names — autumnal, bilious, intermittent, remittent, congestive, miasmatic, malarial, marsh, malignant, chill-fever, ague, fever and ague, dumb ague, and, lastly *the* Fever. So great a variety of names suggests two facts; first, diversity of type; second, wide geographical range of prevalence. I shall use the epithet autumnal, as involving no etiological or pathological hypothesis; and, at the same time, including every modification; but, in speaking of diversities, other terms will find their appropriate places.

II. Variety and Identity. — The varieties of autumnal fever are numerous, and often seem widely separated. Thus, the difference in phenomena between a simple tertian and an inflammatory or a malignant remittent, is greater than the difference between measles and scarlatina; in some years nearly all the cases that occur are intermittent, in others remittent; finally, although the former seem to be but mild grades of the latter, they often prove suddenly fatal; and, that too, without assuming a remittent type. Nevertheless, all the varieties must be regarded as making but a single species; as appears from the following facts: *First.* They prevail at the same times and in the same places. *Second.* Under much variety of aspect, they possess many deep-seated analogies and identities. *Third.* They frequently change from one type to the other. Thus an intermittent turns into a remittent, and the latter, assuming the type of the former, is often seen to become, first, a quotidian, then a tertian, and finally, a quartan. A simple intermittent may, in the third or fourth paroxysm, take on the character of a fatal congestive; and that which begins with an aspect of malignity, sometimes emerges into simplicity and mildness. *Fourth.* Vernal agues attack those who in autumn had suffered under remittent fever, not less than those who had experienced the intermittent form. *Fifth.* The *sequelæ* of all the varieties are almost identical. *Sixth.* The same treatment, with certain modifications, is applicable to the whole. Thus they are manifestly the offspring of the same specific, remote cause; and when no particular variety is in view, may be designated by one epithet.

SECTION II.

GEOGRAPHICAL LIMITS.

Being an endemic of all hot climates, we need not look to the shores of the Gulf of Mexico for a southern limit to our autumnal fever. Its base is, in fact, within the tropics; and prevailing, of course, in Havana and Vera Cruz, it is found wherever there are inhabitants, on the northern coasts of the Gulf, between those two cities. In ascending all the rivers, which discharge their waters into the northern arc of that closed sea, from Cape Florida round to the Panuco river, it is still met with; and, sometimes, as we shall hereafter see, from the influence of local causes, displays greater prevalence and malignity, than it shows further south and on a lower level.

In every other direction than the south, this endemic has its geographical limits. To the east, its barrier is the Appalachian Mountains, into the very gorges of which, however, it ascends by the valleys which penetrate their flanks. But as that chain is not found south of the thirty-third degree of latitude, it has, below that parallel, no eastern limit but the Atlantic Ocean. To the south-west the Cordilleras of Mexico, and the southern Rocky Mountains, constitute its boundaries; while, in higher latitudes, it ceases on the great plains of our western desert, long before we reach those Mountains. From what can be collected out of the travels and expeditions of Lewis and Clark, Pike, Long, Catlin, Fremont, and Gregg, not less than from fur traders and Santa Fe merchants, it is almost unknown at the distance of three hundred miles from the western boundary of the states of Missouri and Iowa, and above the latitude of 37° N. To the north it does not prevail as an epidemic beyond the forty-fourth parallel, and ceases to occur even sporadically about the forty-seventh.

The observations from which these limits are deduced have been made on the resident inhabitants included within them; on travelers into portions of country as yet unsettled; and on the soldiery of the American and British posts. From these army returns I have, with all possible care, constructed two tables, which may properly be introduced at this place. The American returns* purport to be for ten years; but this is true of a few only; and many of the others vary from each other, in the number of years through which they run, whereby the conclusions deducible from them, are entitled to less confidence than if an equal number of observations, in the same years, had been made at each post. As the number of troops was never the same at two different posts, nor during two years at the same, one thousand has, in the returns, been assumed as the mean strength of the whole; and the number of attacks of Fever, and the actual mean strength, have both been brought to that standard. The results offered in the table, then, are not what any post did afford, but what any or all would have given, had the actual strength been at all times one thousand men. At several of them, it will be perceived, the number of attacks exceed the number of men, implying that some individuals experienced several, in the course of the year. The returns are quarterly, but the quarters are those of the calendar year, and therefore, do not exactly correspond with the seasons.

The observing reader will perceive, that this table affords a variety of information; such as the decrease of the Fever in the north — its relative prevalence at different posts in the same latitude — the proportionate number of intermittent and remittent cases, and the comparative prevalence of both, in different seasons of the year.

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* Forry's Statistical Report of the Sickness and Mortality of the Army of the United States; prepared under the direction of Thomas Lawson, M. D., Surgeon General, Washington, 1840.

TABLE

Showing the number of attacks of Autumnal Fever, in the different quarters of the year, at twenty-six Military Posts, between the Gulf of Mexico and Lake Superior — the mean strength being 1000. Arranged according to their Latitudes.

Twenty-six Posts.	Autumnal Fever.	Quarters of the Year. First.	Second.	Third.	Fourth.	Total of the Year.	Comp. of annual ag'gates.
Key West, N. Lat. 24° 33′,	Int'r'nt	70	52	6	51	179	
	Rem'nt	11	00	0	00	11	
	Both	81	52	6	51	190	190
Fort Brooke, N. Lat. 27° 57′,	Int'r'nt	80	190	308	182	760	
	Rem'nt	13	24	28	24	89	
	Both	93	214	336	206	849	849
Fort King, N. Lat. 29° 12′,	Int'r'nt	120	200	460	414	1194	
	Rem'nt	6	41	90	56	193	
	Both	126	241	550	470	1387	1387
Fort Jackson, N. Lat. 29° 29′,	Int'r'nt	82	148	816	367	1413	
	Rem'nt	4	9	128	46	187	
	Both	86	157	944	413	1600	1600
New Orleans Barracks, N. L. 29° 57′,	Int'r'nt	100	60	50	84	294	
	Rem'nt	10	60	80	100	250	
	Both	110	120	130	184	544	544
Fort Wood, N. Lat. 30° 5′,	Int'r'nt	170	137	339	125	771	
	Rem'nt	3	55	218	16	292	
	Both	173	192	557	140	1063	1063
Fort Pike, N. Lat. 30° 10′,	Int'r'nt	28	56	40	31	155	
	Rem'nt	4	23	28	22	77	
	Both	32	79	68	53	232	232
Baton Rouge, N. L. 30° 36′,	Int'r'nt	71	124	220	107	522	
	Rem'nt	40	62	100	100	302	
	Both	111	186	320	207	824	824
Fort Jesup, N. Lat. 31° 30′,	Int'r'nt	26	46	123	44	239	
	Rem'nt	6	12	33	12	63	
	Both	32	58	156	56	302	302
Fort Mitchell, N. Lat. 32° 19′,	Int'r'nt	30	20	60	33	143	
	Rem'nt	4	18	43	17	82	
	Both	34	38	103	50	225	225
Fort Towson, N. Lat. 33° 51′,	Int'r'nt	242	107	450	269	1068	
	Rem'nt	16	37	114	30	197	
	Both	258	144	564	299	1265	1265
Fort Smith, N. Lat. 35° 22′,	Int'r'nt	190	150	445	249	1034	
	Rem'nt	0	5	98	24	127	
	Both	190	155	543	278	1161	1161

Twenty-six Posts.	Autumnal Fever.	Quarters of the Year. First.	Second.	Third.	Fourth.	Total of the Year.	Comp. of annual ag'gates.
Fort Gibson, N. Lat. 35° 57',	Int'r'nt	151	211	491	340	1193	
	Rem'nt	12	19	161	50	242	
	Both	163	230	652	390	1435	1435
Jefferson Barracks, N. Lat. 38° 28',	Int'r'nt	32	63	152	75	322	
	Rem'nt	16	17	76	44	153	
	Both	48	80	228	119	475	475
Fort Leavenworth, N. Lat. 39° 20',	Int'r'nt	100	151	205	143	599	
	Rem'nt	1	3	16	10	30	
	Both	101	154	221	153	629	629
Fort Armstrong, N. Lat. 41° 28',	Int'r'nt	9	70	72	30	181	
	Rem'nt	6	30	73	17	126	
	Both	15	100	145	47	307	307
Fort Dearborn, N. Lat. 41° 51',	Int'r'nt	7	65	102	66	240	
	Rem'nt	3	2	4	2	11	
	Both	10	67	106	68	251	251
Fort Gratiot, N. Lat. 43°,	Int'r'nt	46	286	333	110	775	
	Rem'nt	1	10	16	1	28	
	Both	47	296	349	111	803	803
Fort Crawford, N. Lat. 43° 3',	Int'r'nt	13	40	140	67	260	
	Rem'nt		2	32	7	41	
	Both	13	42	172	74	301	301
Fort Niagara, N. Lat. 43° 15',	Int'r'nt	22	117	52	57	248	
	Rem'nt	18	20	62	20	120	
	Both	40	137	114	77	368	368
Fort Winnebago, N. Lat. 43° 31',	Int'r'nt	3	15	18	13	49	
	Rem'nt	4	0	3	7	14	
	Both	7	15	21	20	63	63
Madison Barracks, N. Lat. 43° 50',	Int'r'nt	24	98	70	35	227	
	Rem'nt	0	0	20	8	28	
	Both	24	98	90	43	255	255
Fort Howard, N Lat. 44° 40',	Int'r'nt	2	11	28	10	51	
	Rem'nt	2	6	22	3	33	
	Both	4	17	50	13	84	84
Fort Snelling, N. Lat. 44° 53',	Int'r'nt	2	9	23	11	45	
	Rem'nt	0	3	11	3	17	
	Both	2	12	34	14	62	62
Fort Mackinack, N. Lat. 45° 51',	Int'r'nt	7	37	16	16	76	
	Rem'nt	1	4	4	4	13	
	Both	8	41	20	20	89	89
Fort Brady, N. Lat. 46° 39',	Int'r'nt	0	16	20	5	41	
	Rem'nt	1	0	2	0	3	
	Both	1	16	22	5	44	44

The British returns* are more limited, for the number of posts are smaller, and the range of country and climates less. They do not, moreover, give the relative number of cases in different seasons, or at the separate stations, and therefore express the prevalence of autumnal fever in Canada, generally, not in particular localities.

TABLE

Exhibiting the Annual Prevalence of Autumnal Fever among the British Troops in Canada.

Ratio of cases to the mean strength of 1,000.

Localities.	Intermittent Fever.	Remittent Fever.	Annual aggr'g'te of both.
Canada, between the latitude of 42° and 47°, from 1817 to 1836, inclusive—20 years, - - - -	79	5	84
Upper Canada, the principal Posts—Kingston, East end of Lake Ontario, N. Lat. 44° 8′—Toronto, North side of same Lake, in 44° 33′—Fort George, mouth of Niagara River, in 43° 15′—Amherstberg (Malden), West end of Lake Erie, in 42° 10′—from 1818 to 1827, inclusive, - - -	178	12	190
Lower Canada, principal ports on the River Richelieu, which connects Lake Champlain with the St. Lawrence, latitude from 45° to 46°—Montreal, latitude 45° 31′, and Quebec, latitude 46° 47′, - - - - - - - - - - - - - - - - -	26	1	27

This table, by embracing the Peninsula north of Lakes Erie and Ontario, together with the banks of the St. Lawrence, down to its estuary, completes what the other left unfinished; and enables us to estimate the relative prevalence of autumnal fever, through every parallel of latitude, from the mouth of the Mississippi, to that of the St. Lawrence, and from Cape Florida, to Gros Cap, at the entrance of Lake Superiror.

We should be aware, however, that the numbers in the tables do not always express, correctly, the cases of fever originating in the localities with which they stand in connection. Thus, Maj. Tulloch, the compiler of the British Report, informs us that many of the cases of fever returned from the posts of Lower Canada, were relapses in patients from the posts of Upper Canada; and in the United States, our troops are often sent to more northern

* Tulloch's Statistical Reports on the Sickness, Mortality, and Invalidizing among the Troops in the United Kingdom, the Mediteranean, and British America: prepared from the Records of the Army, Medical Departments, and War Office Returns, by command of Her Majesty, London, 1839.

posts to recover from the fevers of the south; and thus by relapsing, add not a little to the number of cases at posts which otherwise might have presented but few.

SECTION III.

CONDITIONS WHICH IMPOSE GEOGRAPHICAL LIMITS, AND GIVE UNEQUAL PREVALENCE TO AUTUMNAL FEVER.

I. Soil.—Under this term I include all that composes the surface of the earth, apart from its waters. The loose upper stratum of our Valley consists, as far as its mineral elements are concerned, of the *debris* of the rocks beneath, or of deposits of the *debris* of other rocks, spread over the surface by ancient inundations. There are tracts of country, however, in which the rocks themselves appear at the surface. None of these conditions favor the production of autumnal fever; but, on the contrary, it prevails least where they are most perfectly developed; and hence there is no reason for referring the disease to emanations from a purely mineral surface.

The soil, however, may have another element than the mineral—dead organic matter, both animal and vegetable; and this is its general character throughout the Valley. The amount of this element is very different in different places, for its production depends, *first*, on the fertility of the surface; *second*, on temperature; and, *third*, on moisture. Where these conditions are all present, the growth of organic matter is redundant; where any one or more of them is wanting, it will be correspondingly limited. Thus it is small in quantity in the pine woods of the south (if we except the trees themselves), from the sandiness of the surface; in the desert, beyond the Mississippi, from the same cause, and also from the want of moisture; in the far north from the want of heat, yet it is abundant even beyond the limits to which the Fever extends; on the Appalachian Mountains from that deficiency in part, and from their rocky surface. Dead organic matter is, also, unequally distributed; for the rains wash it down from the hills, and deposit it in the valleys; where, adding to their fertility, it rapidly augments itself, by promoting more luxuriant crops of vegetation.

Now, it is a safe generalization to affirm that, all other circumstances being equal, autumnal fever prevails most where the amount of organic matter is greatest, and least where it is least. A diligent study of the topographical descriptions of *Book I, Part I*, will sustain this conclusion, and demonstrate that decaying organic matter is *one* of the conditions necessary to the production of autumnal fever. As to the mode in which it coöperates, two opinions may be entertained: *First.* It may supply the material out of which a poisonous gas is formed; and, *Second*, It may be a nidus or hot-bed of animalcules or vegetable germs. In either case, we may presume, that all kinds of decomposing organic matter, are not equally favorable to the production of the cause of this fever; but, although I have sought for facts bearing on this question, a sufficient number has not been found to justify their presentation here. I hope the subject may attract the attention of others.

The first breaking up of the soil appears, from a variety of observation, scattered through our topographical descriptions, to be frequently followed by autumnal fever; and, on the other hand, long-continued cultivation is accompanied by diminution of that disease; the element which contributes to its production becoming exhausted.

II. Living Vegetation.—Forests have been thought to modify the conditions which generate autumnal fever. Our medical topography supplies several facts, which go to show, that those who first penetrate our woods, and establish themselves in cabins, closely surrounded by trees, remain comparatively exempt from autumnal fever, till the clearing is extended. On the other hand, it is a disease of the country, and especially of newly-settled parts; where the amount of forest is so great, as to maintain a high degree of humidity. Our cities and larger towns, it is well-known, seldom suffer, and they are to be considered, as in some degree, presenting the very opposite condition from our woodlands. Again, trees have been thought to arrest the spread, of that gaseous agent, whatever it may be, which is said to be the true cause of the Fever; but in what manner they do it, no one can tell. It has been conjectured, that their leaves absorb the noxious exhalation; and also that they mechanically arrest the dissemination of the aerial poison. In harmony with the former hypothesis, is that of Dr. Cartwright (*see p.* 79), in reference to the *Jussieua grandiflora*, and some other aquatic plants, in the delta of the Mississippi; which, he supposes, absorb the agent that produces autumnal fever. I have already expressed the opinion, that the facts do not establish that hypothesis; and must here, in conclusion, remark, that living vegetation is so mixed up with other conditions, necessary to the production of the Fever, that, in the existing stage, of observation, its effects cannot be correctly estimated.

III. Surface Water.—In the maritime parts of Florida, Alabama, Mississippi, Louisiana, and Texas, surface water is abundant, for one side of each rests on the gulf, which has many inlets and little bays, the banks of which, are inhabited. The rivers, moreover, are numerous, and as they approach the gulf, expand into broad estuaries or deltas. The delta of the Mississippi, abounds in lakes, lagoons and bayous. As we ascend this, and the smaller rivers, wide cypress and liquid-amber swamps, annually replenished, skirt both sides. The intervening plains, are cut up by smaller streams, which have wide alluvions, often subjected to inundations; and the country between them abounds in swamps; from which even the sandy, pine plateaus are not entirely free. This continues to be their condition, till we reach the flanks of the Cumberland Mountains, on the east, and those of the

Ozark hills, to the west. As we ascend the Mississippi, to the mouth of the Missouri, we find its annual floods leaving small lakes, ponds, swamps, and lagoons; which in the aggregate, are of great extent, and but partially drained or dried up, before the next inundation. Now, as we have seen, the whole of this region is infested with autumnal fever, beyond any other portion of the valley.

In North Alabama, Tennessee, and Kentucky, swamps are almost unknown, except along the few rivers, which have wide bottom-lands, most of which, moreover, are exempt from inundation. The rivers, however, are sinuous, and in summer, sluggish and pondy; and it is in their vicinity, chiefly, that autumnal fever prevails. In the states of Illinois, Indiana and Ohio, the rivers generally flow through wide valleys, many of which, are liable to be overflowed. Small lakes, ponds and swamps, are also frequent, in certain portions of those states; and it is precisely these localities, which are most infested. To the east of all the states mentioned, as we climb the mountains, the surface water is no longer found in basins; and the streams, generally, have a rapid current, down narrow and rocky channels; and here, autumnal fever nearly disappears; or, when present, is confined to the valley of some stagnating stream. Everywhere, west of the states of Arkansas, Missouri, and Iowa, surface water is scarce; the declivity of the plain which stretches from the Rocky Mountains, favoring its escape; while the subjacent sand almost absorbs, even considerable rivers. Thus, as we advance into that desert, we come at the same time to the limits of surface water, and of autumnal fever. In the north there is no deficiency, for the whole country is essentially lacustrine; and up to a certain latitude, the Fever prevails. Thus the shores of Lake Ontario and Lake Erie, with those of the southern extremity of Huron and Michigan, are infested, and suffer far more than the dryer lands which surround them. But beyond these limits, on the shores of the two latter lakes, and on those of Lake Superior, the Fever, as we have seen, is never epidemic, although water is abundant; and still further north, where small lakes, and their connecting streams, exist in countless numbers, the disease is unknown; showing that, while water is essential to the production of this Fever, other causes must coöperate to give it power.

Let us inquire into the *modus operandi* of this agent in the production of the disease under consideration.

1. Under the influence of solar heat it impregnates the air with vapor, giving a high dew point; and, other circumstances being equal, the evaporation is greatest where the heat is highest. This, of course, is in the southern part of the Valley, and there, as we have seen, the Fever prevails most.

2. Surface water not only contributes largely to the production of a luxuriant vegetation, destined annually to perish, but is indispensable to the decomposition of what it has aided in producing. Hence, without its agency, none of the deleterious gasses, which are supposed to be thus generated, could have an existence. But its presence in any or all quantities, will not

answer equally well. If there be too little, the molecular movements of fermentation are arrested for want of a solvent — if too much, the atmosphere, indispensable to the process, is excluded; or the evolved gases are absorbed and retained.

3. Its presence is essential to those chemical actions, in certain soils, which are believed, by some writers, to generate exhalations that occasion the Fever.

4. It is equally indispensable to the production of both animalcules and microscopic plants.

5. Both evaporation and condensation are known to be accompanied by electrical perturbations.

Thus water is a necessary element, in all the hypotheses which have been framed to account for autumnal fever.

But a contrary and salubrious influence has been ascribed to water; for it is held by many that this fluid absorbs the noxious gas or gases, which they believe to produce the Fever, and thus limits its prevalence. According to this opinion, the deep waters in the center of a basin, may imbibe and retain the noxious gases which the shallow waters of its margins have contributed to generate; and, in support of the hypothesis, it has been affirmed that the vicinity of cataracts and rapids is more unhealthy than the banks of the rivers in which they occur. The absorbed gases are supposed to be there liberated by the agitation of the water. The medical topography of *Book I*, presents several facts bearing on this hypothesis. Thus Wetumpka, at the foot of the long rapids of the Coosa river; Louisville, at the falls of the Ohio River; and Maumee City, at the termination of the rapids of the Maumee River, are all infested with autumnal fever; but other towns, on the same rivers, are likewise scourged with that disease; and Oswego River, which drains the Montezuma swamps of western New York, has at its mouth a great number of mills, yet the inhabitants suffer but little from that disease. It prevails still less at the Falls of Niagara; and finally, at Zanesville, where a natural waterfall has been augmented by artificial means, and on the Kentucky River, where there are series of pools and dams, there is no special prevalence of the Fever. Thus the facts furnished, by our Valley, do not prove that waterfalls eliminate a gas which is the cause of the disease under consideration.

IV. Temperature. — The fact that autumnal fever prevails perpetually and virulently, within the tropics, but ceases long before we reach the polar circle, demonstrates that a high temperature is one of the conditions necessary to its production. Should it be ascribed to heat alone? The answer must be in the negative; for places having the same temperature, but varying in other conditions, are very differently affected with autumnal fever. Thus the people on Mobile Bay suffer greatly, while those who live on the adjoining oak and pine terrace escape; and the summer heat of the southern portions of the great desert is intense, but those who traverse it, and keep at a distance from its water courses, pass the season unaffected. It cannot be affirmed, that the direct action of a hot atmosphere on the body, does *not* contribute to the production of the Fever; for, on the contrary, where it prevails as an epidemic, exposure to the noon-day summer sun is often followed by an attack; but such exposure, in a different locality, will not produce it; and, therefore, we may conclude that in its direct action, heat is merely an exciting cause, on which it is not necessary to expatiate in this place; and I will therefore proceed to trace out its indirect effects.

Our army statistics furnish some instructive facts on this point. The posts which lie along the Mississippi, are placed nearly under the same conditions, in everything but temperature, which varies according to their latitude. They are, therefore, well fitted to indicate the influence of this climatic condition in the production of the Fever. Its relative prevalence at these posts, which extend through more than thirteen degrees of latitude, is presented in connection with the annual and quarterly mean heat, in the first part of the following table, while the second offers a comparison of two posts in the region west of the Mississippi, and the third of two on the Lakes.

TABLE.

	POSTS.	North. Lat.	Annual No. of cases, in 1000 mean strength	Annual mean tempesature.	Mean heat of Winter.	Mean heat of Spring.	Mean heat of Summer.	Mean heat of Autumn.
		° ′		°	°	°	°	°
Along the Mississippi River.	Baton Rouge, - - - -	30 36	824	67.56	52.68	68.72	81.48	67.38
	Jefferson Barracks, - -	38 28	475	56.93	33.98	56.55	76.19	54.38
	Fort Armstrong, - - -	41 32	307	50.65	25.15	50.82	74.57	52.07
	Fort Crawford, - - - -	43 03	301	47.35	20.69	48.25	72.38	48.09
	Fort Snelling. - - - -	44 53	62	45.15	17.29	46.56	71.16	45.59
W. of Miss. River	Fort Gibson, - - - - -	35 48	1435	61.07	42.50	61.26	79.17	61.53
	Fort Leavenworth, - -	39 23	629	52.34	27.60	53.38	74.00	54.39
On the Lakes	Fort Dearborn, - - - -	41 50	251	46.14	24.31	45.39	67.80	47.09
	Fort Brady, - - - - -	46 30	44	40.62	18.06	38.17	62.14	44.13

To show, by a comparison of localities, the exact relation between temperature and autumnal fever, the conditions of the different places should, in all other respects, be alike, which is not often the case; nevertheless, the medical topography and hydrography of the posts, compared together in the foregoing table, will be found substantially the same, and they show, that with the decrease of yearly and summer heat, other conditions continuing unchanged, there is an abatement of the Fever. It is, however, with the heat of summer, and not that of the year, that autumnal fever is connected; and the question here arises, what summer temperature is necessary to the production of the Fever? This question cannot be rigorously answered; for the number of observations hitherto made, in the proper region, is too small to justify a positive conclusion; we may, however, assume, that a summer temperature of sixty degrees, is necessary to the production of the Fever; and that it will not prevail as an epidemic, where the temperature of that

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season falls below sixty-five; finally, that if the other conditions favoring its production are deficient, it will cease before those reductions of temperature have been reached.

According to these conclusions, the Fever will occur in winter, at all places where that season has a mean temperature of sixty degrees or upward; as at Vera Cruz, Tampico, Havana, Key West, Tampa Bay, and Fort King, as may be seen in the table (*p.* 487); and it is well known that cases do occur at those places, in that season; but at the two latter posts, where the winter heat barely rises over sixty, they are few in number. At New Orleans, and generally under the thirtieth parallel, where the mean winter heat is as low as fifty, the Fever is suspended. But the seasons are made up of months, and we are here brought to consider its connection with their respective temperatures.

Up to Tampa Bay, every winter month rises above sixty degrees; but at New Orleans, or the thirtieth parallel, only the nine months from March to November, have that temperature; and as we advance to the north, the number of months having it constantly decreases. Thus, at St. Louis, it is attained by five months only — from May to September, inclusive; at Fort Snelling, by four; at Fort Brady, by three; at Montreal, by four; at Quebec, by three. In advancing further north, June and September fall below it; and, finally, in the distant north, July and August, or the entire year. Long before this reduction is reached by those two months, however, the Fever ceases; and therefore it results, that a continuance for more than two months of a heat equal to sixty degrees, is necessary to the development of the Fever. Hence we can understand, why it prevails more in October than April, although their mean temperatures are nearly the same; in November than June, notwithstanding, the latter is much the warmer month, and in September and August, than July — the hottest month of the year. The greatest prevalence in every latitude, is indeed, generally some weeks, after the hottest month; showing that the effects of temperature are cumulative. It appears from all that has been said, that within the tropics, autumnal fever may occur throughout the year; and that as we move northerly, the duration of its prevalence shortens, by its beginning later in spring, and terminating earlier in autumn. March and November first escape; then April and May on the one hand, and October on the other — lastly June and September.

In contemplating the climatic relations which exist between autumnal fever, and certain aspects of vegetation, we find that in the tropical regions they are the same throughout the year, and that when we attain the thirty-third parallel, which constitutes the northern limit of several southern trees and plants, the prevalence of the Fever is for a much shorter period; that its disappearance is nearly at the same curve, at which the miscellaneous vegetation of the middle latitudes, gives place to the terebinthinate trees and birches, of the north; finally, that maize or Indian corn, which grows all the year round, in the tropical regions, finds the summers too short for the ripening of its grain, in nearly the same curve of summer temperature, at which autumnal fever is arrested.

If change of latitude, by diminishing the heat of the atmosphere and that of the earth's surface can, as we have just seen, arrest the production of autumnal fever, an increase of elevation above the level of the sea, may likewise do it. Thus the Fever which scourges the *tierra caliente* of Mexico, near the level of the sea, is almost unknown in and around the city of Mexico, at an elevation of seven thousand four hundred and fifty feet, although the latitude remains the same. The inhabitants among the sources of the Kenawha and Tennessee Rivers, on the Appalachian Mountains, at a medium elevation of nearly three thousand feet, are almost exempt, while those who occupy the valleys, under the same parallels, are affected; and, further north, at half that elevation, where the Alleghany and Genessee Rivers have their sources, the disease is almost unknown, while on the shores of Lake Ontario, directly north, it prevails. In traversing that mountain terrace, which has a mean summer temperature of sixty-three degrees, I witnessed a frost, on the night of the second of August which destroyed the Indian corn; but, on descending into the valley of the Genessee, which, although a degree further north, is infested with the Fever, the fields of maize were uninjured. Finally, the constantly increasing elevation of the desert to the west of the Mississippi is, no doubt, one cause of the disappearance of the Fever under the same parallels, in which it prevails on the banks of that river.

Having established the paramount influence of high temperature in the production of autumnal fever, it remains to inquire into the modes in which it may operate. I have already referred to its effect as an exciting cause, but this view is too limited, and others must now come under consideration.

1. The long-continued impress of summer heat upon the surface of the body, occasioning copious perspiration, and through the nerves of the skin sympathetically affecting the internal organs, more especially the abdominal, may predispose to this form of fever; and the cool nights of early autumn, acting on the same surface, may still further derange the economy. That such nights, and occasional sudden changes of temperature, are often followed by an immediate development of the Fever, is well known.

2. Heat promotes great evaporation from all moist and watery surfaces, thus giving to the atmosphere a high dew point.

3. It favors the fermentative decomposition of organic matter, and the production of new compounds.

4. It facilitates the multiplication of minute but visible animals, and cryptogamic plants, and may be presumed, therefore, to multiply the microscopic—both animal and vegetable.

5. It evaporates the superfluous water of ponds, swamps, marshes, and lagging streams; thus bringing them into a condition favorable to the more rapid decay of the organic matters which they contain or cover over, and thereby promoting the extrication of gases.

6. It dries the surface of the ground after the rains of spring and sum-

mer; and may (as has been asserted) cause it, in the act of desiccation, to send forth deleterious exhalations, different from those generated in deposits of decomposing organic matter.

6. It disturbs the equilibrium of the electricity of the atmosphere; hence summer thunder storms are of almost daily occurrence, on the coasts of the Gulf of Mexico; but on the shores of Lake Superior they are rare.

Thus solar heat plays an indispensable part, in every hypothesis which has been proposed to explain the origin of autumnal fever; answering equally well for the advocates of combined heat and moisture — miasmatic exhalations — microscopic beings, and atmospheric electricity.

We have now reviewed all the obvious conditions which seem to concur in the production of our autumnal fever, and endeavored to assign the *modus operandi* and influence of each. We have seen the necessity of their concurrence, from the fact that the absence of any one puts an end to the prevalence of the Fever. These conditions are dead organic matter, resting on or blended with the mineral elements of the soil; water, not in any, but a certain quantity; and temperature, above the sixtieth degree, continuing for at least two months. And here we might stop, but for the instinctive propensity of the human mind to arrive at the knowledge of a single efficient cause; to which, therefore, a chapter must be devoted.

CHAPTER II.

SPECULATIONS ON THE EFFICIENT CAUSE OF AUTUMNAL FEVER.

SECTION I.

METEORIC HYPOTHESIS.

It has been suggested, and, indeed, is believed by some physicians, that while the three conditions recognized in the last chapter, are present wherever autumnal fever prevails, but two of them — heat and moisture — exert an influence in its production. Under the joint influence of these elements, vegetation will of course flourish and decay; but not contribute to the production of the Fever. The advocates of this opinion, of course, deny the existence of a special poison; and ascribe the disease to the direct, combined action of a hot, humid, and electrical atmosphere. The discussion of this hypothesis, necessarily involves, to some extent, the discussion of the question of a special agent; for but the two opinions can be held. The

Fever prevails extensively, is often epidemic, and is not contagious; it must have a cause, and if that cause be not some conjunction of the ordinary elements and sensible qualities of the atmosphere, it *must* be a poison, dissolved or suspended in it. If it should appear, then, that the Fever does not depend on the former, we may affirm that it *does* depend upon the latter.

I have already shown, that neither heat nor moisture, by itself, can produce the Fever, and will now proceed to state certain objections to the hypothesis that it results from their combined influence.

1. It is well known, that autumnal fever seldom appears on board of vessels which cruise in the Gulf of Mexico, although the air, at the temperature of eighty, is nearly saturated with vapour.

2. The inhabitants of Key West, who breathe a similar atmosphere, are much less afflicted with the Fever, than those on the Peninsula of Florida, several degrees further north. Now, although that little island supports considerable vegetation, its swamps are filled with the waters of the Gulf in every high tide, and when strong winds prevail.*

3. The sandy banks of Pensacola Bay, from its entrance, up to the town of Pensacola, suffer but little; while, at the head of the bay, where extensive alluvial deposits have been made, the Fever has been so constant and fatal as to prevent permanent settlements. Yet the temperature and moisture of both localities are the same, for they are but ten miles apart.†

4. The pine woods around the Gulf of Mexico, at the distance of only two or three miles from from the estuaries of the rivers, are places of retreat from the Fever, although there is a sea and land breeze, which tends to equalize the humid atmosphere.

5. The inhabitants of the Balize, suffer less from the Fever than those along the rivers of the interior of Louisiana, two or three degrees further north; notwithstanding they are immersed in an atmosphere of great heat and vapour. Vegetation is as luxuriant at the Balize as above; but when it dies, it falls upon a soil impregnated with sea salt, and is often wetted by the waves of the gulf.

6. In many parts of Kentucky and Tennessee, where the surface is dry and ridgy, and the streams narrow and tortuous, the Fever occurs upon the former, although the atmospheric humidity is small.

7. It is well known that a family may settle down in the forest, and cultivating but a small spot, remain free from fever; but when several families arrive, and an extensive breaking up of the soil takes place, it immediately begins to prevail, although the heat and moisture are not thereby increased.

8. Dr. Winter gave me the following fact. On Cedar Creek, a tributary of Cumberland River, a mill dam had been erected about sixteen feet high. After twenty-two years, the basin above having become filled up with silt and drift, the dam was torn down, and the perpendicular face of the deposit, exposed to the action of the sun and air, in the month of August. The consequence of this was, that nearly all the men who performed this labor,

* See p. 47. † See p. 52.

were seized with severe autumnal fever, and one of them died. There was no pond above, nor any marsh in the neighborhood; and the people generally were healthy at the time. Here there was no combined agency of heat and moisture; and hence the facts afford strong evidence of a developed aerial poison.

9. On Paint Creek, Ohio, a millpond was generally drained the first of June, and the rains of that month, washed away the silt and dead plants, and animals; so that the people of the adjoining village of Washington, suffered but little from the Fever; the draining was postponed till July, and no rains followed to wash out the basin. Then there immediately followed an epidemic autumnal fever, which prevailed most on the side of the village next the pond. More than a fourth of the population suffered an attack, and nearly three per cent. of the whole number of inhabitants perished.*

10. It has frequently happened, that individuals who have lodged for a single night in certain localities, have after several days, or even weeks, been taken down by the Fever.† More than this, persons, living in places where it never originates, have been seized in the spring with intermittents, after having in the preceding autumn, traveled where the Fever prevailed. Now it is in no degree characteristic of heat and moisture, to produce *remote* effects. A catarrh, a pleurisy, or a rheumatism, comes on soon after exposure, or not at all. The development of the disease, at a distant time from that at which the remote cause was applied, clearly suggests, that the cause was something else, than a particular condition of the sensible properties of the atmosphere.

11. At our different salt works, the operatives spend their lives in a hot atmosphere saturated with vapour; and, yet, on the whole, are more exempt from fever, than the surrounding population ‡

12. Lastly, in some of our manufacturing establishments, the in-door artisans and operatives, labor in a heated atmosphere supersaturated with vapor, but remain free from autumnal fever.

These facts seem to me conclusive in their bearing against the meteoric hypothesis; except so far as certain atmospheric conditions may act as exciting causes; and we are therefore, thrown upon the alternative — a deleterious agent, diffused in the atmosphere; the positive existence of which, seems to me to be established, by the facts which have been cited.

Now this agent may be either one, of two kinds — inorganic or organic — and both have a *prima facie* advantage over the hypothesis we have examined, in demanding the concurrence of all the conditions — heat, water, and dead vegetable and animal forms — which have been shown to be always present, wherever autumnal fever prevails; while the last is left out of account by the meteoric hypothesis. We must first inquire into the origin and nature of the inorganic poison.

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* See p. 291. † See p. 370. ‡ See pp. 261 and 404.

SECTION II.

MALARIAL HYPOTHESIS.

I. It is unnecessary to inquire into the nature of the gases, which may be exhaled from an *earthy* surface, consisting of *nothing* but the fragments and powder of the subjacent rocks, and the different salts, or oxides, formed by their decomposition, under the influence of heat, water, and atmospheric air; for no such surface exists in our Valley. Whenever the rocky strata are thus exposed, they begin to crumble; and the pulverulent layer then immediately becomes the *nidus* of some kind of plant; thus, lichens overspread the hardest rocks, and, by their death and decay, add to the thin layer of mineral matter, an organic element, at once vegetable and animal in its composition. In this way, the spot becomes prepared for a vegetation of a higher order, which, in turn, augments the amount of organic matter; while the rock beneath, by continued disintegration, continues to contribute new mineral substances. Thus it is, that the loose upper crust of the earth is accumulated; and the nearer we come to the actual surface, the greater, in proportion, are organic elements, or those fixed compounds which are formed by its decomposition. The soil thus formed may vary exceedingly in its depth; for where the rock has undergone rapid disintegration, or the *debris* have favored a luxuriant vegetation, the soil will be much deeper, than in opposite circumstances; but there is still another source of inequality. The soils thus formed are not fixed, and consequently are liable to be drifted about by currents of water. In ancient times, great portions of the Valley, on the north side of the Ohio River, were deeply covered with this kind of drift or diluvium; and down to the present time, every considerable rain or dissolving snow, but especially the former, washes a portion of the soil, with its superincumbent dead plants and animals, into the valleys, where they are speedily deposited.

But the soil of every inhabitable part of the Valley has, at all times, resting on its surface, a layer of dead and decomposing organic matter; which is abundant in proportion to its fertility, and its favorable exposure to rains and the heat of the sun — that is, to those conditions which cherish the growth of animals and vegetables.

Now, in the study of medical topography, with reference to autumnal fever, our attention has been generally directed to this layer only; and as there may be some physicians who even doubt the existence of those organized and decaying forms, in the soil beneath, supposing that they suffer decomposition when they disappear from the surface, it may be well to say something more on this subject.

The soil, of which the analyses are given at *pages* 75, 76, and 293, all contain organic matters, which, in one, more than equal all the inorganic substances. One of the specimens examined was silt, taken from a point ten feet below the surface, in New Orleans; and Professor Riddel found, that nearly one fourth consisted of "organized matters, such as the sporules or germs of algæ, animalcules, and their ova;" and at the depth of sixteen feet, in sinking the gas tanks of that city (*p.* 76), wood was found, which had the texture of cheese, when the spade passed through it. The length of time required for the Mississippi to deposit the sixteen feet of superincumbent silt, must have been indefinitely long. Again: In parts of Ohio, where there is a deep diluvial or post-diluvial deposit, when wells are dug, plants unknown in the neighborhood often appear upon the earth which has been thrown out, and doubtless spring from seeds, which had lain buried for an immense length of time. Still further: Where the upper crust is composed of sand, but produces the kinds of vegetation that can grow on such a surface, the decaying organic matter is washed into the ground by rains. Thus it is that the manure or mold, that is spread on the white sands of the gardens of the navy yard at Pensacola Bay, rapidly disappears. In this way, a spot which seems destitute of dead organic matter, may have an admixture of that element below the surface. From these facts, we are warranted in reaffirming, that the soil and subsoil, of all parts of the Interior Valley, contain organic matter, in every stage of decomposition.

II. We come now to consider the dead and decaying organic matter deposited on the surface. This does not consist of vegetable forms merely, as we too often suppose, but likewise of animal. An inspection with the naked eye, and still more with the microscope, reveals to us that innumerable insects, and other minute animals, live and perish among vegetables. Many tribes, moreover, find their sustenance and abode in the decaying remains of plants. Still further, the surface and superficial parts of the ground teem with small quadrupeds, reptiles, and worms; while the trunk of every fallen tree, in a certain stage of its decay, abounds in various kinds of grubs or larvæ. From the moldering remains of trees and other vegetables, moreover, spring mushrooms, algæ, lichens, and other cryptogamic plants, which abound in nitrogen beyond the higher order of vegetables, and have, in fact, nearly the same chemical elements with animals. Finally, wherever there are pools, or swamps, or running streams, there are fishes, moluscæ, and crustaceæ, which multiply and perish, and whose bodies then float and dissolve, or sink to the bottom, or are thrown upon the shores, and mingled with the remains of land animals and plants. Thus, a vegeto-animal layer overspreads the surface of the country; and under the combined influence of water, heat, and air, when the two former are in the right proportions, is constantly undergoing decomposition, and originating new chemical compounds.

III. But the organic covering of the surface is, by no means, of the same nature in every locality. We cannot tell what kind of plants and animals, in past ages, left their remains on what now makes our subsoil; but the existing forms are subjects of observation, and, in the investigation which occupies us, should not be entirely overlooked.

1. The trees, in what are called the pine woods of the south, are chiefly resinous, and abound in hydrogen. Vegetable matters having such a composition are little disposed to pass into fermentation, but are decomposed by the slow combustion of several of their principles, by the oxygen of the

atmosphere; and if the efficient cause of autumnal fever be a gas, formed during the fermentative decomposition of organic matter, we have here one explanation of the comparative absence of that fever in those woods.

2. The *gramineæ*, *equisetacea* and, indeed, all kinds of grasses, contain in their culms and blades a great quantity of silicate of potash, and in their seed much phosphate of magnesia and lime. They undergo decomposition very slowly, and the results cannot be the same as those of plants widely differing from them in composition. In describing the medical topography of the Balize (*page* 90), the extensive and luxuriant growth of the *Phragmites communis*, *Typha latifolia*, and *Scirpus lacustris*, was mentioned; and I have already conjectured that their falling, when dead, into brackish water, may modify their mode of decomposition; but we may also believe that their composition exerts an influence; and that, on the hypothesis that the Fever is the offspring of the decomposition of organic matter, one cause of its milder prevalence, at the final termination of the Mississippi, than along the same river above, may be the peculiar composition of its reigning vegetation. Again: the vegetation on the grand prairies, beyond the Mississippi, is chiefly gramineous, and to this, on the same hypothesis, we might, perhaps, consistently attribute some portion of their exemption from the Fever.

3. The oak tree abounds in tanno-gallic acid, and is often the governing tree in considerable tracts of forest; which, I think, are less infested with the Fever than localities having a diversified, arborescent vegetation. At all events the *exuviæ* of such a forest might be expected to afford the elements for gaseous exhalations of a different sort from those of pine, or of trees not abounding in that acid.

4. The *leguminosæ*, including all kinds of pulse, as peas, beans, and lentils, contain very little potash, silica, or the earthy phosphates, while they abound in nitrogen, and must, therefore, while under decomposition, yield gases of a very different kind from the *gramineæ*.

5. The extensive natural family of plants called the *cruciferæ*, embracing the radish, mustard, turnip, and cabbage, contain sulphur and nitrogenized ingredients, fitting them to give out, in decomposition, gases varying from the last.

6. Not to pursue the subject any further, the *fungi*, *boleti*, and other cryptogamic plants, which abound in dark and shaded woods, have a composition almost animal, and cannot, in their spontaneous decay, afford results of the same kind with plants of a widely different composition.*

IV. The facts which have been cited teach us that there is, mingled with the soil or resting upon it, a great amount and endless variety of organic matter, both animal and vegetable, to the decomposition of which, and to the resulting new compounds, the malarialists look for the efficient cause of autumnal fever. In doing this, a special stress may, with great propriety, be laid on a few unquestionable facts.

* Liebig: Chem. applied to Agricul. and Phys.

1. That, all other circumstances being equal, the Fever prevails most where the organic matter is most abundant, in or resting on the soil.

2. That where the surface is not moist enough to favor the decomposition of organic matter, the Fever has but little prevalence.

3. That a temperature of sixty degrees of Fahrenheit, or above, is necessary to fermentation and putrefaction, and that the Fever ceases, in going north, when we reach a summer temperature below that degree.

4. That particular localities have experienced the Fever, in an epidemic form, when a surface abounding in organic matter has been newly exposed to the action of the summer sun.

5. That under long cultivation, which exhausts the organic matter of the soil, and prevents its accumulation on the surface, the Fever almost ceases to appear.

V. These facts undeniably establish a connection between a certain condition of the surface and autumnal fever; but they do not prove the existence of malaria, or a *gas*, which is the efficient cause of the Fever, and to this point we must now give attention.

1. The observed aeriform products of this decomposition are carbonic acid, carbonic oxide, carbureted hydrogen, sulphureted hydrogen, and carbonate of ammonia. Now, there is not a single fact going to show that either of these gases can produce autumnal fever. On the contrary, as the result of experience, it may be safely affirmed, that they do not; for the effects which follow on exposure to them are of a different kind. But it can be said that, in the endless variety of new compounds, which nature may form out of the ultimate elements of plants and animals, there may be many which have not yet been detected, and that some one of these is the efficient cause of the Fever, and this cannot be denied. But we must not forget that it is an assertion without proof — a mere suggested hypothesis — a proposition to be proved.

2. It is well known to us all, that there are sickly and healthy seasons at the same place, and sometimes over large portions of our Valley, while the amount of organic matter remains unchanged; and, as yet, it has not been shown that this can be explained by a reference to varying degrees of heat and moisture, though the subject has not received sufficient attention to show that it cannot.

3. The Fever occasionally appears in limited localities, from which it is in general entirely absent; the surface meanwhile remaining, to all observation, precisely the same.

4. All the known gases are either simple bodies, as hydrogen and chlorine, or binary compounds of two simple elements, as carbonic acid, ammonia, and carbureted hydrogen, and their principles are united in definite proportions, giving to each a uniform and peculiar character. If we may depend on analogy, the assumed undiscovered gas, called malaria, must be of the same character; and, therefore, at all times and places be productive of the same effects. Now, although autumnal fever is a disease of intrinsic uniformity, it shows modifications which have not been explained by the assignment of

modifying causes; and without such causes, its diversities constitute an objection to the existence of a single agent of an unchangeable character.

On the whole, therefore, I must repeat, that while the conditions under which our autumnal fever appears, are sufficiently clear to observation, the existence of a special gaseous agent, resulting from them, remains to be proved.

SECTION III.

VEGETO-ANIMALCULAR HYPOTHESIS.

I have united two words to express an hypothesis which ascribes autumnal fever to living organic forms, too small to be seen with the naked eye; and which may belong either to the vegetable or animal kingdom, or partake of the characters of both.

In the year 1832, I published in the Western Medical and Physical Journal, of which I was the editor, a series of papers on Epidemic Cholera, which were afterward collected and enlarged into a small volume;* in which an attempt was made to show, that the mode in which that disease spreads, was more fully explained by the *animalcular* hypothesis than any other which had been proposed. The brief investigation then given to the subject, reinspired my respect for the opinion long before expressed, that autumnal fever, and many other forms of disease, might be of animalcular origin; and the discoveries since made by the Ehrenberg school, have seemed to render that doctrine still more probable. But I have neither had time nor means for experimental or bibliographical inquiry; and do not propose to dwell very long upon the subject in this place.

As applied to Epidemic Cholera I regard the hypothesis of animalcules as more plausible than that of vegetable germs; but in reference to autumnal fever, either may be assumed; and in support of the assumption, I proceed to make the following observations:

1. The microscope has revealed the existence of a countless variety of organic forms, which surround and penetrate the bodies of larger animals and plants, whether living, or dead and decaying, inhabit all waters, salt and fresh, and swarm in the atmosphere; buoyed up and moving by their own organs, or sustained by their levity, and wafted about by currents of air. The difficulty of detecting them in the atmosphere is greater than in water, or when attached to solid substances; but to my own mind, it seems probable that they exist in the aerial ocean in greater multitudes than elsewhere. For, *first*, minute particles of matter, organic and inorganic, are at all times floating in that ocean, and may serve as their food or resting places; and, *second*, as the surface of a body becomes greater, in com-

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* A Practical Treatise on the History, Prevalence, and Treatment of Epidemic Cholera. By Daniel Drake, M. D. Cincinnati: 1832. Pp. 180.

parison with its weight, the more it is reduced in size, it follows that living, organic forms, both animal and vegetable, may be of such size, as to float permanently in the air. The power of reproduction, possessed by these microscopic creatures, is still more wonderful than their minuteness. It exceeds, indefinitely, all examples presented by the visible organic kingdom; where, however, we see the government of the same law, for, in both plants and animals, the small multiply more rapidly than the large. In contemplating the invisible living world, in which the visible is, as it were, immersed, the mind becomes bewildered, as in meditating on the infinite, and requires to fall back upon obvious facts. Now one of these facts is, that whole rock formations, of great thickness and extent, have been found, under the microscope, to be composed entirely of the silicious shells or coverings of animalcules. In such beings, the increase seems to be merely by secretion from, or division of the parent body.

2. Among visible plants and animals, there are species that form no poison, and others which secrete that, which applied to, or inserted in our bodies, produces a deleterious effect, which is generally of a definite kind. Thus, the venom of the rattlesnake produces a disease of definite form; cantharides another; certain fish are poisonous when eaten; wasps and bees instill a venom; and the smallest visible gnat, as that which inhabits the forests of the middle latitudes, and that which is known under the name of sand fly on the shores of the Gulf of Mexico, inflames the skin; while the juice of stramonium, the exhalations of the rhus toxicodendron, and the fungus which grows beneath its shade, excite peculiar diseases. It seems justifiable to ascribe, by analogy, to microscopic animals and plants, the same diversity of properties which we find in larger beings, differing from them, as we may presume, in nothing but size and complexity of organization. We may suppose, then, that while many species of this minute creation are harmless, there are others, which can exert upon our systems a pernicious influence. This, moreover, is in accordance with what we know of gases, some of which, as nitrogen, are inert, while others are deleterious. Under this head, moreover, we must not forget the fact, that nearly all the animals and plants which secrete a poisonous fluid, grow in the southern regions, and we may, analogically, suppose that the microscopic beings in those regions are more pernicious than those of higher latitudes. Now it is in the warmer portions of our Valley, that autumnal fever has its greatest prevalence.

3. We know that water is essential to the support of those animal and vegetable forms which are matters of observation by the unassisted eye; and may conclude, therefore, that it is equally necessary for the tribes which are invisible. Indeed, it is known of many, as the *rotiferæ*, that if deprived of moisture, they seem to die, but may be revived many years afterward by the application of water. Now we have seen that, in the western part of the Valley, where great aridity prevails, the Fever is almost unknown; while it prevails with greatest frequency and violence, other conditions being the same, where there is adequate humidity.

4. A high temperature is favorable to the development of animal and vegetable life. In the southern parts of the Valley, animal forms, especially of the lower order, are greatly multiplied, and vegetation is luxuriant. If this be true of the visible, why may we not conclude that it is equally true of the invisible. Now, it is precisely in those regions, that the Fever, other circumstances being equal, displays its greatest prevalence and malignity. When we look to the north, we find that, after reaching the parallel which has an isotheral curve of sixty degrees Fahrenheit, the amount of visible organic life is much diminished, and continues rapidly to decrease; we may therefore presume, that the same is true of microscopic plants and animals. But we have already seen, that where the summer temperature falls below sixty degrees Fahrenheit, autumnal fever is unknown.

5. In the visible organic world, we find animals subsisting on plants, or on other animals that have fed on vegetables. Again: the decomposing remains of one generation of plants, favors the growth of another; and thus the soil gradually acquires the ability to bring forth a more luxuriant crop. Organic matter is, then, the proper, though not sole nutriment of organized beings. Such being the law, we may presume that, *cæteris paribus*, where dead organic matter is most abundant, microscopic tribes will be most multiplied. It is a familiar fact, that such matter abounds, through almost every stage of its decomposition, in visible beings, which subsist upon it. Thus flesh has the larvæ of the green and many other flies; rotten wood its grubs; vinegar, as the result of decomposition, its eels — sometimes visible to the naked eye; cheese its visible and invisible inhabitants; and bread its mold, a cryptogamic plant. Finally, all vegetable infusions, when exposed to the air, have their *infusoria*. It is impossible, then, to doubt, that myriads of microscopic beings swarm around, and enter the interstices of all dead organic matter; and thus we have reason for believing, that they prevail most, where such matter is most abundant; and it is in the same localities, other circumstances being equal, that we find the greatest prevalence of the Fever.

6. By the vegeto-animalcular hypothesis, we can explain the concentrated prevalence of the Fever in certain places, as rationally as by the malarial hypothesis. Thus, its virulent reign at the head of Pensacola Bay, where there are extensive deposits of river alluvion, may be referred to the multiplication of animalcules or germs, where they find abundance of nutriment; and in the case of the exposure of the face of a deep stratum of silt by the removal of a mill-dam on Cedar Creek (*p.* 717), we have only to suppose, that they immediately began to multiply upon the denuded surface.

7. It has, often, been observed, that the Fever has suddenly increased after rain; and this might have arisen from the resuscitation of organic forms rendered torpid by previous drought.

8. It may be, that cold produces a state of suspended animation in these as in many larger animals, and in numerous plants; and that the first warm weather of spring revives and sets them to multiplying; when they generate, what are called vernal intermittents (or at least, a part of such cases); the

origin of which cannot be rationally ascribed to malaria developed at that time.

9. Microscopic observation and analogy render it probable, that in the invisible, as well as the visible province of the organic kingdom, there are distinct species, which constitute, by their union, natural families or orders. We know that in each natural assemblage of the larger plants and animals, the species resemble each other in many internal qualities, as well as in their forms. Thus, an astringent principle pervades the various kinds of oak; a resinous principle the linear evergreens; an aromatic oil, the peppermint, and other didynamous herbs; a poisonous principle, the different species of rhus; and that a narcotic principle pervades a large assemblage of plants. We know, also, that these various active principles in each group, are in general analogous, but not identical; whether we examine them by their sensible properties, with chemical reagents, or observe their effects upon the living body. Now, may it not be, that two distinct species of the same natural order of microscopic beings, may produce autumnal fever? May not one be the cause of intermittents — the other of remittents? may not both act on the system at the same time? and may we not thus explain diversities, which are inexplicable on the malarial hypothesis? Every practical physician knows, that while the juice of a variety of plants will produce the pathological condition called narcotism, the symptoms of that state, when induced by different agents, differ as widely from each other, as the symptoms of the different forms of autumnal fever.

10. In discussing the meteoric hypothesis, it was said, that the pathological effects of a certain condition of the principles of the atmosphere, are always immediate; and it might have been remarked, when treating of the malarial hypothesis, that as far as we know, the effects of gases are likewise immediate; but we are certain that autumnal fever often begins many days, and even weeks or months, after an exposure to its remote cause. Now we know, as a general fact, that many animal poisons do not develop their effects, till after the lapse of a greater or less length of time Thus, two weeks may elapse before small pox will appear, after exposure; and two years have passed away, before hydrophobia has followed on the bite of a mad dog. On this point, then, the vegeto-animalcular hypothesis, has an advantage over both the others.

11. It has been already stated, that autumnal fever prevails very unequally in different years; and that, in the same locality, it may, in one autumn, be malignant and epidemic, and in another, mild and sporadic. This can, perhaps, be better explained on the hypothesis we are now discussing, than on either of the others; for we know, that throughout the visible organic domain, reproduction is by no means uniform. A year of great abundance, may be followed by one unproductive, in the vegetable kingdom; and in the animal, one summer and autumn will be infested by insects far beyond another. It has often happened, that musquitoes have been absent, from the banks of the middle portion of the Ohio river, for a year, and in the next appeared in immense numbers. We have but to suppose

insect forms of a parallel size, to live under corresponding laws, and the hypothesis now before us, offers an explanation of sickly and healthy seasons.

12. It is well known that the long-continued cultivation of the soil, and the building of towns and cities, diminishes the prevalence of the Fever. Now this cultivation implies the drying up of a great deal of surface water; the burning up of the natural vegetation, and the gradual decomposition of that which has been mingled with the soil. Summer crops, as those of wheat and hay, are also removed, and not suffered like the natural herbage to accumulate on the surface; and those of autumn are either removed, or in the course of the winter consumed, to prepare the fields for new planting. Thus the food of microscopic beings is destroyed, and their reproduction arrested.

13. We are familiar with the fact that many persons never sicken with autumnal fever, while others around them will have repeated attacks. This is ascribed to difference of susceptibility, and of exposure to exciting causes. Such ascription is no doubt correct; but the vegeto-animalcular hypothesis offers, from analogy, an additional explanation. It is well known that certain visible insects prey on some individuals much more than others — seem to be attracted by one and repelled by another — and we have but to grant to the invisible the same tastes and instincts, to understand that some persons may always draw swarms around them, while others escape their depredations.

14. People who inhabit houses built on the hills adjoining valleys, are said to suffer more than those who reside below. Now every breeze may waft and lodge in such habitations the microscopic beings which multiply in the rich and humid valley-soil. It has also been observed, that a grove of forest trees between an inhabited house, and what is called a sickly spot, gives comparative immunity from the Fever; and may not the leaves of such trees as successfully arrest animalcules, or vegetable germs, as they can absorb a gas not designed for their nourishment?

From what has been said, it appears obviously, I think, that the etiological history of autumnal fever, can be more successfully explained by the vegeto-animalcular hypothesis, than the malarial. But both, in the present state of our knowledge, must stand *as mere hypotheses.* Neither can claim the rank of a theory; nor will it be entitled to the confidence of the profession until many additional facts are brought to its support.*

IV. VALUE OF THE DISCOVERY OF THE EFFICIENT CAUSE OF AUTUMNAL FEVER. — I cannot, *a priori*, attach much practical importance to a discovery of the *efficient* cause of autumnal fever; and have devoted several pages to its discussion, from deference to my brethren, much more than from my own conviction, of the value of the discovery to which so many minds are directed.

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* When this article was about to be sent to the press, a friend handed me Professor Mitchell's Lectures on the "*Cryptogamous origin of Malarious and Epidemic Fevers,*" which I had not before seen. The array of facts made by the learned author, seems almost irresistible; and, from his distinguished reputation, it will, no doubt, lead many others into new courses of observation and experiment.

Did we know the particular meteoric condition, the gas, or the organized microscopic species which produces the Fever, we should not probably be able to defend ourselves against it, by any precautions, but those which experience has already established; nor should we be able to destroy the efficient cause, without annihilating the conditions under which it is generated. Those conditions are already well known. The individual exposed to them is liable to an attack — he who keeps away remains exempt. The people of the country escape the vesicular eruption produced by the *rhus toxicodendron* or the *rhus vernix*, by keeping beyond the sphere of exhalation. They know nothing of the nature of the poisonous emanation, and yet their means of protection are as perfect, as those of the chemist would be, who might analyze the poison and give it an appropriate name. Nor is it probable that the discovery of the efficient cause would throw any light upon the treatment. It was not a knowledge of its cause that taught us the cold treatment of small pox; — we know the cause of hydrophobia and yet cannot cure it; — we do not know the cause of goitre, but have discovered that iodine is an efficient remedy.

Ignorant, however, as we are of any definite, efficient cause for autumnal fever, I am a full believer in its existence, and shall speak of it as a specific agent, known only by its effects on the living body. These effects constitute the disease we have been studying in its etiology; and are now to contemplate in its symptomatology, pathology, and therapeutics. In proceeding to do this, the first inquiry naturally is, into the manner in which the assumed agent makes its impress on the system. In doing this, I wish it understood, that if I should, at any time, use the word malaria, it is merely to designate the remote cause, *whatever* it may be.

CHAPTER III.

MODE OF ACTION AND FIRST EFFECTS OF THE REMOTE CAUSE OF AUTUMNAL FEVER.

SECTION I.

APPLICATION OF THE POISON.

Assuming the existence of a poison concealed in the atmosphere, we are led to inquire on what surfaces it makes its primary impression.

I. Action on the Skin. — Several known gases act with such energy on the cutaneous surface, that when they are applied, for some time, they produce decided effects.* But can this be affirmed of the cause of autumnal fever? Does it modify the vital properties, and pervert the functions of the skin; and, through sympathy, the organism generally? Does it penetrate that integument and mingle with the blood? There are facts which seem to favor an affirmative answer, to at least one of these questions. *First.* Exposure of the surface of the body to the night air, in early autumn, is often followed by an attack of the Fever. *Second.* The functions of the skin, both perspiratory and calorific, are signally impaired in the forming stages of the Fever. In opposition to the first of these facts, it is well known that a hearty meal, a debauch with wine or whisky, the action of a hot sun, or the violent operation of a cathartic, when the Fever is epidemic, may invite an attack; and the exposure of the body at night, may, like them, be only an exciting cause. In opposition to the second I may say, that the other functions of the body are impaired, as early and extensively, as those of the skin. Proof is wanting, then, that the remote cause acts upon or penetrates the skin, to the production of this fever, though the opposite cannot, in the present state of our knowledge, be established.

II. ACTION ON THE STOMACH AND BOWELS. — The remote cause has been supposed to exert its primary influence on the gastro-intestinal mucous membrane, or to enter the circulation through that surface. The facts in support of this opinion are: *First.* The early derangement of the functions of the stomach, liver, and bowels, evinced by loss of appetite, nausea, increased or suppressed secretion of bile, and constipation, or diarrhœa. *Second.* The actual development, in many cases, of gastro-enteritis. *Third.* The alleged necessity of admitting the latter condition, as requisite to the production of the Fever.

But these facts are inconclusive, and the objections to the hypothesis many. In the *first* place, as I have said of the lesion of the functions of the skin, those of the digestive organs have no priority over lesions of other functions. Muscular langor, impaired perspiration, diminished heat, heaviness of the head, reduced activity of the mind, and pain in the back, or several of these symptoms, are as early in their appearance as the disorders of the digestive organs — sometimes earlier; for every physician has met with cases, in the forming stage of the Fever, in which he found it necessary to prohibit the patient from eating. In the *second* place, both the symptoms and the required treatment of numerous cases, show that gastro-enteritis is not present. Indeed, splenitis is oftener present than mucous inflammation, and hepatitis is by no means uncommon; but the cause of the Fever cannot reach either of those organs without penetrating others. And if *they* can become inflamed, without being directly acted on by the poison, the existence of gastro-enteritis is no evidence, that it has made its first impression on the stomach and duodenum. In the *third* place, the influence of a hearty meal (in cases in which the appetite has not been destroyed), in exciting the Fever, and even developing gastritis, does not prove that the cause had

* Edwards on Physical Agents. Muller's Physiology. Christison on Poisons.

acted on the stomach; for if the organism at large had felt its influence through whatever channel, and the stomach had then been irritated by a meal, which it could not digest, the sympathetic relations between it and the whole system might, at once, arouse inflammation in the former, and fever in the latter. In addition to these objections it may, in the *fourth* place, be asked how an agent so subtle, as to have hitherto escaped detection, can find its way into the stomach, in such quantities as to prove injurious, either by its action on the mucous membrane or its passage into the blood? It could only reach there, by being mingled with our food and water; which, for aught we know to the contrary, may be the case, but I know not of a single fact in support of this opinion.

III. Action on the Lungs. — If the cause of autumnal fever be mingled with the atmosphere, it must be received into the lungs; for universal experience shows that it is not one of those gases which provoke a closure of the glottis, and thereby occasion its own exclusion. Does it, then, make its primary, morbific impression on the pulmonary mucous membrane? In support of the affirmative of this question, it may be stated, *First.* That the area of that membrane is sufficient to admit of an extensive contact of the aerial poison. *Second.* That its susceptibility to the action of gases is far greater, than that of the skin or gastro-enteric membrane; and, therefore, as compared with them, it is more likely to be the surface on which aeriform poisons make their primary impression. It may be objected to this hypothesis, however, that the function of respiration is less impaired in the early stages of this fever, than most of the other great functions, and that bronchitis is but seldom developed. The former is entitled to consideration, but the latter is not, inasmuch as all morbific agents do not necessarily excite inflammation in the parts upon which they act; and, it has not yet been shown, that the cause of autumnal fever is one of those which do. Nevertheless, I cannot regard the opinion that autumnal fever has a pulmonary origin, as anything more than a hypothesis. As nitrogen, oxygen, and some other gases have been found to enter the circulation through the skin, it is possible that the cause of this fever may be introduced in the same way. Should it be introduced into the stomach and bowels, it might thence enter the blood, as there is reason to believe that certain gases do.* But passing by these surfaces, as altogether subordinate, we may turn to the pulmonary, as that through which most gases pass into the circulation. Of the reality of this absorption, no physiologist can entertain a doubt. In fact, it seems to be almost as much a function of the pulmonary membrane, to absorb certain gases and odors, as it is of the gastro-enteric, to absorb liquids. Thus Dr. Edwards† has demonstrated the absorption of oxygen, azot, hydrogen, and aqueous vapor, by the lungs. Others have confirmed his observations, and rendered the absorption of other gases highly probable; finally, all the world is familiar with the fact, that a great variety of odorous exhalations are likewise absorbed — often rapidly and copiously. Such being the penetrability

*Christison, page 698. †Edwards on Phys. Agents.

of the pulmonary membrane, there is no anatomical or physiological objection to the theory, of the passage of the efficient cause of autumnal fever, through that tissue into the blood; still this does not prove that it is absorbed — only that it may be. But are there no proofs of the fact? I know of none, which do more than render it probable. *First.* We have seen, that there is no evidence, that the morbific impression of this cause is made on the skin or mucous membranes with which it is in contact; and yet its action on the system is a reality, hence we may conclude that it penetrates through some surface to the blood. *Second.* As various gases, vapors, and odors, penetrate the thin parietes of the vessels of the pulmonary membrane, we may conclude, from *analogy*, that the efficient cause of this fever may do the same. *Third.* Dr. Stevens has shown that, in the endemic fevers of the West Indies, the blood suffers deterioration before the phenomena of fever have manifested themselves in the functions of the solids. *Fourth.* The universality of functional lesion, and, in most cases, its equality among the different organs, in other words, the involvement of the constitution would seem to indicate, that the remote cause has acted throughout the whole organism at the same time. *Fifth.* A prominent and most dangerous condition in autumnal fever, is the impaired state of the calorific function, found in its highest degree in algid intermittents. As the blood, evidently, plays an important part in this function, may we not conclude that in these remarkable cases, it has undergone a change in its composition or constitution, which unfits it for the development of caloric? Whatever may be the agency of the nervous system in this function, it is undeniable that the blood is immediately and deeply concerned; and, highly probable, that its agency is according to chemical principles. Should it then be altered in its constituents, or their mode of union, an alteration in its calorific agency would be inevitable. It must not be forgotten, however, that in the stage of febrile reaction there is increased heat. Nevertheless, there are cases in which, during that stage, the extremities continue cold. *Sixth.* An argument in favor of this hypothesis may, perhaps, be found in the well-known fact that a suppression of perspiration, by lodging in the open air, tends to excite the disease, and that a copious perspiration, effected by art in the forming stages, often arrests it. While the function of perspiration continues active, the poison absorbed by the lungs may pass off through the skin; but being arrested in that exit, may, by its accumulation, prove mischievous, and when it has already begun to do harm, a copious sweat may relieve the system of such an amount, that fever may be averted. *Seventh.* Nearly connected with these views, and tending to the same point, is the fact, that as long as the nights continue warm, the disease does not become epidemic; but as soon as they become so cool as to check the functions of the skin, by diminishing its capillary circulation, and surrounding it with a damp atmosphere, from the liberation, by the reduction of temperature, of a portion of vapor which was insensible at a higher degree of atmospheric heat, the Fever assumes an epidemic character.

SECTION II.

MODE OF ACTION.

Supposing the agent which produces the Fever introduced into the blood through the lungs, what may be its mode of action? Experiments by various physiologists and chemists* have shown, that in reference to their effects upon the living body when inspired, the known gases may be divided into the inert, the irritant, and the narcotic. Of the first class, are azot and hydrogen, which prove injurious entirely or chiefly by excluding atmospheric air. To the second class belong nitric oxide gas, nitrous acid vapor, muriatic acid gas, chlorine, sulphurous acid, and ammonia; all of which irritate in a sensible manner, or inflame the aerial passages, and some of which, in a very dilute state, if inhaled for a considerable time, prove narcotic. In the third group are comprehended sulphureted hydrogen, carbureted hydrogen, carbonic acid, carbonic oxide, nitrous oxide, cyanogen, oxygen, ether, and chloroform, in which the narcotic greatly predominates over the irritating property.

Judging by its first effects, as found in the early stages of autumnal fever, to which of these classes should we refer the cause of that fever? Not to the inert, which destroy life simply by excluding the atmosphere, for it causes no such exclusion; not to the exclusively irritant, for, as we have seen, they inflame the respiratory membrane; not to the entirely narcotic, for somnolency is not a prominent symptom of the early stage of that fever. Relying on its effects, to guide us in an estimate of its character, we may say, that the efficient cause of this fever is a peculiar poison, of a sedative and irritating quality, somewhat like the narcotico-irritating gases, or certain solid and fluid bodies, which, in large doses, destroy life suddenly, by reducing power, and in smaller portions, weaken while they pervert the functions. *Assuming* this, let us inquire concerning its action, first on the blood, and secondly on the solids.

1. In reference to the blood, we can only regard this agent as something absorbed and mingled with it: a foreign substance united with the water, in which the saline and animal ingredients are dissolved or suspended. Of its effects on these, or the manner in which they are produced, we are profoundly ignorant. Still, as the introduction of a foreign ingredient, into a fluid so compounded, cannot be made without disturbing the equilibrium of its affinities, and changing its isometric character, we are bound to admit a deteriorated condition of that fluid, if the absorption be a reality. From the physiological relations between the blood and the containing solids, from the moment this condition is established, the action of the former upon the latter, must be different from what it is in health; and the change, however brought about, is to disease. The influence of such a blood on the nervous system, and all the organs of secretion, not less than on the heart and vessels, being different from what that influence is, when the blood is in a

* Christison, p. 689.

normal condition, the functions performed by those great structures, are necessarily altered; and here may be the origin, in part, of the first symptoms of the fevers we are considering.

2. But the agent which has passed into the blood, may retain its integrity, and produce effects peculiar to itself, by acting on the parts with which it is brought into contact. These are the entire internal surface of the arteries, veins, and heart. That this surface is of vast extent, we are taught by anatomy; and that its arterial portion, at least, is exquisitely alive to the impress of foreign matter, has been equally demonstrated by experimental physiology. That the heart is endowed with a high degree of irritability, was shown long since by Haller; and that it possesses nerves, has been proved by Scarpa. That the smaller arteries and capillaries are likewise endowed with nerves, has been demonstrated by Lucae;* that they are the seats of the liveliest sensibility, is obvious to every observer; and that the nervous system exercises over their circulatory and secretory functions, a constant and decided influence, has been established by the experiments of Sir Wilson Philip and others; if, indeed, it has not forced itself upon the attention of every observing physician, in the modifications of secretion and calorification, which result from varying states of the innervation. Such is the surface with which the absorbed and undecomposed poison is brought in contact. A surface not protected, like the skin, with cuticle; not limited to a group of organs, and defended with mucus, like the pulmonary or gastro-intestinal membrane; but undefended; more extensive than the whole of those taken together; found in every organ of the body, and most developed in those which perform the most vital functions.

3. If we concede to the cause of autumnal fever, a peculiar narcotico-irritating quality, its necessary effects, in such a mode of application, will be those which constitute the first stage of that fever — reduction of vital energy, obtuseness of sensibility, suspended or perverted secretion, and diminished calorification; and from an equal necessity, they will be felt in all parts of the body, because the agent which produces them travels with the circulation. We may assure ourselves, that its first effects will not be increase, but depression of excitement, by referring to the constitutional influence of foreign matters, liquid or gaseous, when introduced into one of the serous membranes (as the peritoneum, for example), which are always those of depression as well as irritation. If we suppose such matters to be simultaneously introduced into all the serous sacks of the body, we should expect immediate reduction of the vital powers, and early death; though we can conceive of the quantity being so small, that the system would react, and fever and inflammation ensue. I can see no logical objection to this analogy.

4. If we combine these effects, with those supposed to be produced by the altered state of the blood, and with the whole, those which must necessarily and immediately result to that fluid, from the reactive influence of the

*Beclard's Anat. Gen.

diseased solids, we have before us the pathological state which constitutes the first effect of the remote cause, and the first stage of the Fever; a state which the hypothesis (for it cannot be regarded as an established theory) seems adequately to explain; and, by explaining, to commend itself to our consideration and confidence. Having now accomplished the object proposed in this chapter, let us proceed to inquire into the development of the Fever.

CHAPTER IV.

VARIETIES AND DEVELOPMENT OF AUTUMNAL FEVER.

SECTION I.

VARIETIES.

The first effects, or morbid impressions, produced by the remote cause of our autumnal fever, are so nearly the same, whatever may be the subsequent type, that in many, indeed, in most cases, that type cannot be seen through them. In their incipient stages, the different forms of this fever are not, in general, to be distinguished; but as they advance, a difference in type manifests itself; and as a first division we separate them into intermittents and remittents.

I. Intermittents. — The intermittents of our Valley, are generally quotidian or tertian, oftener, I think, the latter than the former. Now and then a double tertian challenges the acumen of the physician, in distinguishing it by the hours of recurrence, or the violence of the alternate paroxysms, from a quotidian. An *original* quartan I have never seen; but quotidians occasionally assume that character. Whatever may be its type, as to periodicity, our intermittent fever presents several varieties or modifications, founded on pathological causes, or conditions.

1. It may be mild, simple, accompanied by a perfect intermission; and if not combatted by art, may, still, not prove dangerous; though it may continue to the impairment of the constitution, which is true of both quotidians and tertians.

2. It may exhibit a deep or protracted cold stage, with imperfect reaction; and in the first, second, or some subsequent paroxysm, prove fatal; and this also may be true of that which recurs daily, or every other day. These are the malignant or congestive cases; the former epithet for which, should be preferred, as not involving a hypothesis, or directing the attention of the physician upon a single pathological condition.

3. It may assume an inflammatory character, with a diminished cold, and a prolonged hot stage, running at length into a remitting type.

II. Remittents.—1. These are generally characterized, in their varieties, by the same language as intermittents. Many of them are simple, and without much active treatment, after running a course of eight or ten days, terminate in health, or in simple intermittents. This is oftener the case in the middle than the southern latitudes.

2. Other cases, from the beginning, or in their progress, display a decidedly phlogistic character, with signs of inflammation in some organ, and a tendency to a continued type.

3. In various localities, especially to the south, a form of this fever has received the name of congestive or malignant. It appears to differ from the malignant intermittent, in the absence of a regular apyrexia; from the simple remittent, in the mixed up, ataxic, and threatening character of its symptoms; and from the inflammatory remittent, in the signs of great prostration, and the absence of an open inflammatory aspect. Cases of this kind are much rarer than cases of malignant intermittent.

4. The first two varieties of remittent fever often terminate in intermittent. That the last does not so frequently, may be ascribed to the amount and activity of treatment which is necessary to the recovery of the patient.

5. Intermittents left to themselves, rarely cease till they have continued for a long and indefinite time. But they may be made to cease at any period of their duration. It is not necessary to defer the means of their arrest, till a number of paroxysms have returned, as some physicians have imagined. Remittents of a simple character, on the contrary, as I have already intimated, will cease of themselves; and cannot so certainly be cut short in their early stages, as intermittents. I have not, however, seen, or been able to collect, evidence of critical days in this fever. Its duration, very commonly, is a week or more, rarely a fortnight, except when complicated with manifest inflammation of some organ, or when they manifest a typhous character.

6. Why is it, that the cause, whose effects we are considering, produces fevers of a periodical type? I know not that any answer can be given to this question. It is the specific effect of the remote cause. It results from the relations between that agent and the living system on which it acts. When we can tell how the variolous poison produces cutaneous pustules, the morbillous a rash, and mercury a salivation, we may be able to tell, why autumnal fever is essentially periodical, and not before.

7. Nor is it plain, why the same remote cause will occasion an intermittent in one, and a remittent in another; why one shall have a quotidian, another a double tertian, and another a tertian; or, why several shall have simple, and one a malignant intermittent, when all inhabit the same locality. Perhaps, however, varieties of constitution and exciting causes, with unknown modifications of the remote cause, may be looked to, for a solution of this difficult problem. On the last, my late colleague, the learned Professor

Caldwell,* has laid a degree of stress, which might arrest our attention, if the cause of these fevers, in any of their varieties, had been discovered; and, if they did not all prevail at the same time, in the same places.

It might be presumed that the statistics of these varieties of fever would throw light on this subject. The table at *p.* 706 presents the relative proportions of intermittents and remittents at twenty-six military posts. If these be divided into southern, middle, and northern groups, we find that for the southern, the remittents make twenty-one per cent.; the middle fourteen per cent., and the northern twenty per cent. Thus, it does not appear, that temperature exerts an influence on the relative number of intermittent and remittent cases. But may not humidity? Let us consult the table on this point. Six posts around the Gulf of Mexico, give for remittents twenty per cent.; and seven on the Lake shore, give thirteen per cent.; while eight along, or west of the Mississippi, where the atmosphere is dryest, give only ten per cent. From these numbers it would appear, that humidity *increases* the proportion of remittents. But can we adopt this conclusion? I think not; for ordinary observation has shown that remittents are even *more* common than intermittents, on dry ridges, while in deep valleys and other humid localities, intermittents prevail. It must be, then, that while the army reports may be correct as to the aggregate, they are not to be relied on, for the relative number of intermitting and remitting cases. The mean of the twenty-six posts is about eighteen per cent. of remittent fever; but from several yearly reports, kindly communicated to me by Dr. Silas Ames, of Montgomery, on the high bluffs of Alabama River, in N. L. 32°, the proportion of remittent cases is about forty-three per cent. of the whole, occurring in his practice. Since these statements were prepared for the press, I have met with a transcript of the records of the Charity Hospital, New Orleans, for seven years, by Dr. Fenner,† which presents the proportion of remittents, at but ten per cent. of the whole! Such discrepancies show how little reliance can be placed on the attempted classification of autumnal fever into intermittent and remittent.

SECTION II.

DEVELOPMENT AND PATHOLOGICAL CHARACTER.

Having studied the *modus agendi* of the remote cause of autumnal fever, and enumerated the varieties of type under which it appears, we are prepared to inquire how they are developed. In doing this, we shall regard them as constituting, essentially, one pathological state; and in studying its modifications, we shall become acquainted with the causes, of some of the modifications presented in its symptoms, and the varieties of treatment which they render necessary.

* Prize Dissertation on Malaria.

† N. O. Med. and Surg. Jour., July, 1848.

I. Of the Forming or Cold Stage.—This commences with the initial morbid impression, which we have already considered; and, in simple or inflammatory cases, terminates with the access of the hot stage, to be reproduced, on the next or some subsequent day. This paroxysmal character, not less than the symptoms which characterize this stage, shows, that the function of innervation is deeply involved and embarrassed. We may, in fact, admit, that it is the first affected. The state of the circulation, equally indicates that the forces which maintain it, are reduced. The heart is enfeebled, and the coöperative action of the vessels, however it may be exerted, has failed in a corresponding degree. Hence the blood no longer flows in normal quantities, through the more exterior or peripheral portions of the body, but retreats to, or rather remains in, the organs of the cranium, chest, abdomen, and pelvis. Under this condition of the two great functions of innervation and circulation, the secretions become still further impaired, than at the beginning. The perspiration is suspended; and, in many cases, the exhalation from the lungs is reduced, because the respiration is brought down; and the blood seems not to favor the extrication of what is exhaled in health. The urinary secretion is, also, reduced in quantity; and the bowels are not in the soluble condition which indicates a due secretion of the *liquor intestinalis*. But of all the secretions, that of the liver is most affected, or at least the signs of biliary derangement are greatest. A yellow tinge of the urine, skin, and eyes, is often among the earliest of the morbid appearances. In many cases, especially the more simple, the liver pours out torrents of bile; which, in part, ascend through the pylorus, raise a bitter taste in the mouth, and impart yellowness to the otherwise white fur upon the tongue. In other cases, the secretion of bile is nearly, and, in many of the more violent cases, entirely suspended; or what is thrown out by the gland is of a vitiated quality. It was this disturbed condition of the hepatic function, that procured for autumnal fever the name of bilious, and has so often suggested its treatment. How are we to account for the constancy and prominence of these symptoms in this form of fever? Shall we say, that a plethoric state of the portal viscera is their proximate cause? In many other fevers, we have an equal concentration of blood, in the internal parts, without an equal increase or perversion of the hepatic functions; nevertheless, we may admit turgescence as one of the pathological causes of increased or even suspended secretion of bile; according to the degree of engorgement and the reduction of energy and activity in the solids. But something must be sought beyond this. We may admit, that from the sympathy between the skin and liver,* the great heat of the preceding summer has raised the liver into high and deranged functional action. We may, also, conjecture, that the action of the remote cause, wherever it may impress itself first, is, from its nature, determined upon the liver; as the virus which produces scarlatina or erysipelas, determines its action upon the skin, or the

* Johnson on Tropical Diseases.

mucous membranes of the throat. We may assume, that if the remote cause be received into the blood, the constitution — *vis conservatrix* —makes an effort to convey it out of the system, through the liver, as phosphorus passes out in the state of phosphorus acid from the lungs, when injected into a vein;* sulphur through the skin, and various saline substances, through the kidneys. In all these cases, the foreign matter excites the organ upon which it directs itself or is directed, into increased secretory action; and in like manner the cause of the Fever, in circulating with the blood, may be concentrated on the liver, and promote the secretion of bile. Finally, we may perhaps admit as a possibility, that this foreign material contributes to the development in the blood, of the elements of the bile; which it is the function of the liver to combine and excrete. But, casting aside every attempted explanation, we must receive, as an established fact, that, even in the first stage of every variety of autumnal fever, the biliary function is signally deranged. Another equally characteristic feature of the Fever, is the derangement of the calorific function. This extends not only to the actual heat of the patient, but to the sense which takes cognizance of temperature. The calorific function, in many cases, seems, in the more external parts of the body, to be almost annihilated. Potential stimulants will not reëxcite it; and the external application of heat, is actually less efficient in warming the limbs of the patient, than in warming an equal bulk of dead and dry matter; because the exhalation that is constantly going on from the moist tissues, which seem to be brought into a condition which favors the escape of vapor, cools them In many of these cases, the patient does not shiver, nor complain of cold, because the functions of his nervous system are too deeply smitten, to admit of their action on the muscles, or of his taking cognizance of the loss of caloric. In others, of less violence, the muscles are affected, and he shakes, complaining at the same time of the sensation of coldness. Finally, I have seen cases, in which these symptoms were present, while the heat of the surface was not below, or was even above the standard of health. Such anomalies show, that both the califacient function, and the sensibility to caloric, are in a disordered condition. It would perhaps, be in vain to inquire, why this function is so preëminently affected in this fever; especially, in many of its intermittent forms. The fact, like that of periodicity, would seem, in the present state of our knowledge, to be ultimate. We must refer it to the remote cause, and await its explanation in the progress of the science.

Let us now turn our attention to the dangers, and the causes of death in this stage of the disease.

As already intimated, the cases in which a sense of coldness, with a rigor or a shake, is most developed are, in general, least dangerous. The very existence of the feeling and the muscular contraction, shows that the vital properties have been less scathed, than in cases in which those phenomena do not appear. Reaction soon manifests itself in such cases, and a stage of

* Nysten, Dic. de Sciences Medicales.

open, perhaps, violent excitement follows, to be succeeded either by a remission or intermission, and then to be renewed. But in more dangerous cases, a different series of events is encountered.

1. The vital powers may be so reduced that the patient will die, as individuals die under the influence of prussic acid, or some other poison of a like kind. His susceptibility to the various sustainers of life is annihilated, and he sinks. Or if, according to the laws of relation between this aerial poison and the living system, a reaction take place, it is feeble and partial, and he perishes in the access of the next paroxysm.

2. During the time that the forces which maintain the circulation are thus depressed, the blood may stagnate in the brain, or accumulate in the lungs, the heart, or the portal circle, in such quantities as to suspend the action of some of these great organs, and by its apoplexy, occasion the death of the whole.

3. The blood itself, under the combined influence of an absorbed poison, the retained elements of the excretions, defective aeration, and the reactive influence of the morbid solids; may become unfit for the support of the great functions which depend upon it, and death be the necessary consequence.

But these various pathological conditions, are not to be regarded as having a separate existence, for they are combined, and although one of them may predominate in one case, and some others in another, according to idiosyncrasies, predispositions, and the influence of accidental causes, they may all, in certain cases, contribute to the same fatal termination.

II. Of the hot Stage, or stage of excessive Excitement.—Naturally, that is according to the laws of relation between the remote cause and the living system, if the patient should not die, in the stage which has just been described, it is succeeded by that now under consideration, of which it is the pathological cause. The morbid action has taken a turn — the vital forces have risen from their depression, and excitement is reproduced; but it is morbid. To what cause are we to ascribe this change?

1. It is a physiological law, that after depression there shall be elevation. From mere lapse of time, if not too strongly depressed, the organs recover their vigor, and begin to react. Various functions are restored; but they are morbid, in proportion as the cause which depressed them was foreign in its nature from the agents which maintain life. To this tendency — this spontaneous revival of irritability and sensibility — we may ascribe, in part at least, the revival of excitement, and the production of the hot stage. If the constitution be vigorous, this revival is more likely to take place — if previously feeble, it may be sunk below the point of spontaneous reaction.

2. When the blood is not too much vitiated, its centripetal accumulation may provoke the heart into reaction.

3 We may, perhaps, admit, with Sir Wilson Philip, that the retained sanguineous excretions may, sometimes, irritate the heart into reaction; but this would probably only happen in the milder cases, in which that fluid had not become deeply altered.

4. Should the vital properties of any internal organ have suffered less

than the rest, the hyperæmia, into which it is thrown, may at an early period establish inflammation in it, the very commencement of which would tend to raise the excitement of the system.

5. Lastly, the external and internal stimulations, to which we subject our patients, contribute to the same result.

But in whatever way it is brought about, when death does not happen in the stage of depression, high excitement ensues, and other phenomena, indicating new pathological conditions, offer themselves to our notice.

1. The blunted sensibilities of the patient become morbidly acute — pain occurs in parts not previously affected, or becoming sharp where before it was dull.

2. The heart, in most cases, acts with unwonted force, and the blood is thrown toward the periphery of the body; but circulates with a rapidity which brings it speedily back upon the viscera.

3. The calorific function is not only restored, but becomes excessive, and the intolerance of heat is augmented.

4. The liver acts with uncommon energy, and the secretion and excretion of bile are correspondingly great; at the same time the bilious hue may become deeper than before, indicating either return of bile into the blood from the liver, or extraordinary development of its elements in that fluid.

5. After the lapse of a few hours, in the intermittents, and of a longer portion of a day, in the remittent form, this excitement abates, and an intermission or remission is declared by the tranquillity of the patient, the abatement of force and frequency of his pulse, and the occurrence of more or less perspiration.

6. It may happen, however, that when the stage of excitement comes on, some organ or organs, will remain in a state of hyperæmia, and pass into inflammation. These are, generally, the viscera of the abdomen, chiefly the spleen, liver, and gastro-enteric mucous membrane.

a. Splenitis is so common an accident in our autumnal fever, especially our inflammatory intermittents, as to suggest that we can nowhere look for the true anatomical character of that fever more successfully than in the spleen. Why it should be so great a sufferer cannot, perhaps, be told, except that it becomes greatly engorged in the forming stage of the Fever.

b. Next to the spleen, or equally with it, the liver is liable to fall into inflammation upon the access of the hot stage; but this is more especially the case in the remittent type.

c. The mucous membrane of the stomach and duodenum, with that of the common gall duct, are liable to pass into the same condition.

Thus, all the subdiaphragmatic viscera, except the pancreas, are subject to inflammation in this fever. Sometimes, however, from idiosyncrasy, or the coöperative action of certain causes, inflammation arises in other parts. Thus an inflammation of the brain or its envelops may happen; and when the Fever makes its attack, late in autumn, the combined action of vicissitudes of temperature and that of the specific cause, developed at an earlier period, may determine the inflammation upon the lungs or pleura. Wherever the inflammation may be seated, it complicates the case, and creates a new kind of danger. Although it may abate with the subsidence of the hot stage, it does not cease. The affected organ shows signs of suffering during the apyrexia, which it renders imperfect. The succeeding exascerbation may be prolonged by it, and an intermittent may thus be converted into a remittent; while the latter not unfrequently, as already said, passes nearly into a continued type, from the same pathological cause. But the most dreaded combination of this kind, which we meet with in the Valley, is that in which an inflammation of an organ is associated with such depression of the general forces of the system, that but a feeble reaction occurs. That this is a reality, both the symptoms and post-mortem appearances have shown. Such inflammations are never very acute. The organ is greatly engorged; but the actions which constitute inflammation are feeble; and, after death, appearances which indicate congestion or passive hyperæmia, are more conspicuous than the vestiges of true inflammation. Between these cases and mere congestion of the organ, there is often but a shade of anatomical difference.

Having considered the origin and mode of invasion of the remote cause of autumnal fever, the nature of the morbid impression, and the consequences of that impression in the production of the cold and hot stages of the various forms, we have continued our generalization to its legitimate limits, and must now, by analysis, resolve what we have treated as one pathological state, into several; that the peculiarities of each may be presented. In doing this, we shall recur to the varieties enumerated in a preceding chapter.

CHAPTER V.

INTERMITTENT FEVER—SIMPLE AND INFLAMMATORY.

Much time has been devoted, by the nosologists, to the division of intermittents according to their periodicity. Regarding such classifications as of little practical value, I shall pass them by, and adopt that which seems best fitted to suggest the variety of treatment, which in this country they require. This classification, as already made, is into simple, inflammatory, and malignant; which terms do not represent three different diseases, but grades or modifications of one, which often presents intermediate shades, that obscure the lines of distinction. I shall commence with the first.

SECTION I.

SIMPLE INTERMITTENTS—HISTORY AND PATHOLOGY.

I. History.—It is quite unnecessary to give an elementary description of this variety. From south to north, its symptoms, progress, required treatment, and sequelæ, have been found substantially the same, and quite identical with those of all other times and countries. Persons of every age are liable to it; the young rather more than the old; and even infants at the breast are by no means exempt. I have not seen, but have heard of one congenital case. Its attacks are generally preceded by an exciting cause; such as irregularities in diet, or a debauch; above all, getting wet and cold, or sleeping exposed to the night air. A long ride through the dews of night, or under the hot sun, of an early autumnal day, will alike excite it.

II. Pathology.—I shall not dwell on the pathology of simple intermittent fever. My firm belief in the existence of a specific, remote cause, has been already expressed. The simplest morbid condition, which results from the action of that cause, is the variety of autumnal fever now under consideration. To its cause it bears a relation, not unlike that of small pox, scarlatina, or epidemic cholera, to the agent which produces that malady. A stage of reduced and perverted excitement, ending in a chill. with shivering of the muscular system, is followed by a reactionary fever, which ends in a perspiration, to be succeeded by a state of comparative health; the whole concluded within twenty-four hours. The disease may, in one sense, be said to have run its course, when the first paroxysm terminates; and to be, therefore, essentially an ephemera. In this respect, it might be compared with epilepsy, which has its forming stage (often very short), its convulsive stage, and its sleeping stage; immediately after which, the patient begins to enjoy his usual health. But, unlike the epileptic fit, the paroxysm or fit of fever returns, every day, or every other day, or at more distant intervals. In many cases, this repetition, which at the beginning was daily, comes to be every other day, or every seventh day, or every fifteenth; each paroxysm being shorter than the last. But as each has added to the disturbance of the constitution, when the disposition to recurrence has ceased, certain consequences may remain. *First*, an anemic condition of the blood; *second*, enlargement of the spleen; *third*, anasarca; *fourth*, neuralgia. During the time the paroxysms are thus recurring at stated periods, it may be reproduced at irregular intervals, by exposure to cold and moisture. When *suffered* to recur until it ceases spontaneously, the patient not unfrequently remains ever afterward free from the malady; although continuing exposed to the action of the remote cause. But whether treated or not with medicines, he may experience future attacks of neuralgia, with a quotidian or tertian recurrence.

Simple intermittent fever, never proves fatal but by the lesions which the long-continued repetitions of its paroxysms occasions. The most important of these have been enumerated. Such being the case, we know nothing of a particular anatomical character, invariably present in its early stages. We know of no organ affected in advance of all the rest, and radiating a morbid action throughout the whole. We see a disturbance of the whole, in which some may suffer more deeply than others; but *with* them, not *before* them. We see a deep implication of the nervous system, from the first to the last paroxysm, with that kind of involvement of the sanguiferous and secernent systems, which gives us the phenomena of fever; but we do not see the symptoms of inflammation—above all, the evidences of an *antecedent* inflammation. Such is the disease the treatment of which we are now to consider.

SECTION II.

TREATMENT OF SIMPLE INTERMITTENTS.

I. I have met with a number of physicians, who are accustomed to make but little effort to arrest simple intermittents, until their patients have experienced several paroxysms. The reason assigned for this delay was, that the earlier in its course the disease is arrested, the greater is the danger of relapses. This may be true, for the longer time from the application of the remote cause, the less will be its impress; but as the habit of recurrence, in all periodical diseases, is soon established, as much may be lost from that cause, as is gained from the other. Moreover, the patient in whom the malady is promptly arrested, soon lays aside every remedy, and begins to expose himself to exciting causes; while he who has suffered long, is disposed to cling to the former and avoid the latter. On the whole I see no reason for delay in resorting to remedies. These I shall include under two heads—Preparative and Curative.

II. Preparative Treatment. — 1. *Bloodletting.* — In the beginning of simple intermittents, we often find much vascular fullness, and during the hot stage, a considerable resistance in the pulse, with great heat, thirst, jactation, headache, backache, and pains in the periosteum of the long bones. Such a concourse of symptoms, would seem to indicate a phlogistic diathesis; but in reality they are the expression of a febrile condition only, and in a few hours will entirely cease, to be renewed the next day, or the next but one. Shall we admit that in this condition the lancet is demanded? The answer, I think, should be, that whenever the constitution is vigorous, and the physician is called to an early paroxysm, bloodletting is not only safe, but will both mitigate the symptoms, and prepare the system of the patient for other remedies; which, in many cases fail, or succeed but imperfectly, from the tone and fullness of the vascular system. The blood which is drawn is generally free from buff. It has been affirmed that liberal venesection will of itself cure the disease. This may be true, for sudden and copious depletion will produce great changes in the state of the functions; under which the disposition of the system to return to the morbid condition may be lost. A preference has been given by some physicians* to bloodletting in the cold rather

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* Dr. McIntosh, of Edinburg, and many practitioners of the Interior Valley.

than the hot stage. As far as it relates to the preparation of the system for subsequent measures, it perhaps makes no difference in which stage of the paroxysm the blood is drawn; but as the cold stage is often cut short by the operation, it may be well to resort to it in that stage. It is undeniable, however, that the greater number of simple intermittents can be, and are arrested, in every part of the Valley, without a resort to the lancet.

2. *Emetics.*—In the early settlement of the states bordering on the Ohio River (constituting what was then called the Western Country), when but few Anglo-Americans had, as yet, immigrated into the northern or southern portions of the Interior Valley, emetics were among the fashionable remedies in the treatment of simple intermittents. At that time, it was the custom of every physician whom I knew, to administer them. But for the last twenty-five years, they have been discontinued by many, and but seldom prescribed by others, in this form of fever. Has this disuse arisen from the discovery that they are injurious, or even useless? I think not; but from causes entirely different. After the estuaries of the rivers emptying into Lake Erie were settled, malignant intermittents mingled themselves with the simple; and, after the states of Mississippi and Alabama became peopled, a similar combination was encountered; and it was discovered that emetics, by their prostrating influence in those intermittents, often did harm; and that, in the first paroxysms, the simple could not be distinguished from the malignant. Under such circumstances, it became prudent to limit the administration of emetics; and as modes of practice are diffusive among the physicians of every country, this limitation spread into regions where it was not demanded. But another, and, perhaps, greater cause of this restriction, was the theory that the disease we are considering, is an intermittent gastritis, in the treatment of which emetics could not fail to be injurious. To these causes we may, I think, ascribe the decline, but not extinction, of the emetic practice.

My own experience, with that of many others, leads me to commend emetics in this form of fever. When the circumstances already recognized as suggesting venesection exist, let it be first employed—when they do not, an emetic may be the first remedy. A free and full evacuation of the stomach is followed by a decided improvement in its condition, by a tendency to sleep, and an abatement of the dryness of the skin, if not an actual perspiration. The emetic may be given during the hot stage, if the arterial system should not be plethoric; or it may be administered in the intermission, or at the access of the chill, which it often shortens, and sometimes averts. In fact, when the disease has lasted for a while, a powerful vomit just before the shake, is one of the successful modes which the people adopt, for arresting the disease. It carries into the system a perturbation, in which the paroxysmal tendency is lost. As a preparatory remedy, an emetic empties the stomach of undigested food, and the acids resulting from indigestion or morbid secretion. Very commonly, however, instead of acids, a liberal quantity of regurgitated bile is thrown up, from the beginning, or at the close of the operation. Great comfort, and much abatement of all manifestations of disease, generally follow such an operation, and the stomach is prepared for the favorable action of other remedies.

3. *Cathartics.* — In the commencement of simple intermittent fever, the bowels are generally sluggish, if not torpid, and charged with feculent matters and bile. A cathartic is, therefore, indispensable, whether an emetic be first administered or not. Of this cathartic, calomel should always be an ingredient, as a complete emulgence of the hepatic ducts, is a desideratum. The old-fashioned dose of ten grains of calomel with ten of jalap, with or without one grain of tartarized antimony, is equal to any other formula; but calomel, in a dose of ten, fifteen, or twenty grains may be given alone; and after its alterant action has been exerted on the liver, its cathartic effect may be quickened by an infusion of senna, with or without sulphate of magnesia. The best time for the operation to take place is in the decline of the hot stage. If that stage should be intense or prolonged, the bowels may not be obedient to the impress of the medicine, when a liberal bleeding will bring on free and full purging. In some cases the liver is in a high state of functional excitement; and there is an uncommon development of the elements of the bile. Such a condition is indicated by yellowness of the eyes, a sallow complexion, and a tongue covered with a heavy yellowish fur, large quantities of bile being at the same time brought away by the operation of cathartic medicines. It is quite possible, however, to attach too much importance to the removal of these symptoms, and to be over anxious for a clear and healthy tongue before proceeding to other measures. In short, I can see no sufficient reason, for a continuance, through many days, of a treatment which, carried to any extent, will seldom arrest the disease. Indeed, I suppose it would be better to leave the patient to himself, than by the daily repetition of drastic evacuants, to reduce his strength, and irritate, if not inflame, the mucous membrane of his stomach and bowels; for, if brought into such a condition, he would *not* be prepared, but rendered unfit, for the treatment which is essentially remedial.

III. Curative Treatment. — If I should dwell on this head, it will not be on account of its difficulty; but for the purpose of discussing a therapeutic principle, and the *modus operandi* of a medicine, applicable to all the varieties of autumnal fever. Tested by their symptoms, obvious pathology, and the treatment found most successful, these fevers, I may here repeat, cannot be grouped with the phlegmasiæ, or inflammatory fevers depending on common causes, and curable by a routine, antiphlogistic method; for many of them will not yield to that treatment, and others, if sometimes cured, are more tractable under a plan, of which that method is but a part.

As already affirmed, autumnal fever, in all its varieties, is in fact, a peculiar disease, depending on a specific cause, modified in its nature or effects, by causes which are often as little known as the specific cause; and although it may cease spontaneously, or be arrested by various means, which establish in the system a new action, at the expense of the febrile, it does not follow, that among the latter, there may not be some, whose action shall be so antidotal, that of right they should supplant the others, and be regarded as the true and proper remedies. One of these is the cinchona bark, and its preparations. Before the discovery of the latter, the bark was in general use throughout the Valley, and seldom disappointed our expectations; but the fashion of administering it has passed away, and one of the compounds formed from it has come into universal use. That compound I shall take, therefore, as the representative of the cinchona and all its preparations, in the present discussion.

IV. THE SULPHATE OF QUININE.—This medicine cannot be referred to the class of simple diffusive stimulants, such as capsicum or ammonia, which, in large doses, excite inflammation and fever; nor to that of tonics, as gentian, columba, and the carbonate of iron; for although in minute and regularly repeated doses, it will, to a certain degree, excite and sustain the actions and energies of the system, these effects are by no means those which characize it, as a therapeutic agent. It has, perhaps, better claims to be admitted into the order of sudorifics, for increase of perspiration, generally follows its administration, if the system and the regimen of the patient, be favorable to such an effect. With greater propriety, however, it may be grouped with the sedative and antispasmodic narcotics; but not with the soporific division, for it does not, like opium, produce sleep. When its operation, in liberal doses, is noticed, it will be observed, to diminish the frequency and spasmodic force of the heart's contractions; expand and soften the pulse; increase the functions of the skin; and tranquilize the innervation. Its sinister effects on the brain, are vertigo; on the organs of sense, *tinnitus aurium* and temporary hardness of hearing. The last is analogous to the effect of some other narcotics, as stramonium, and belladonna, on the pupil of the eye. In generalizing, the phenomena which follow its exhibition in considerable portions, we may say, that its action is directed more on the great sympathetic, and the muscular system of the apparatus of organic life, generally, than upon the functions of animal life; another point of distinction between it and opium. Two opposite conditions of the system contraindicate its use. 1st. A high degree of phlogistic diathesis with arterial fullness; 2d. Great depression of the vital forces.

The effects which have been ascribed to it, characterize it as a medicine, which produces, in the innervation, a peculiar change; and constitute it an alterant of a particular kind. Now this effect, as experience has shown, stands specifically opposed to the effect produced by the cause of autumnal fever; and on this accidental opposition depends its efficacy, in all the varieties (though not all the stages and complications) of that fever. In reference to *them*, it may be said to be antiperiodical and antidotal. It is not, however, infallible; for its curative relations to autumnal fever, are like those of mercury to syphilis, or of iodine to goitre and external scrofula. If they succeed beyond all other known remedies in those diseases, so does the sulphate of quinine in the diseases of which we are now treating:—if they, occasionally, require preparatory and adjuvant treatment, so does it; if they sometimes fail, so does the remedy we are considering.

I have said, that I should take the sulphate of quinine, as the representative of the cinchona bark, but it seems proper here to remark, that their effects are not precisely the same, though doubtless both act on the same principle, in arresting the paroxysms of the Fever. The bark is destitute of a diaphoretic property, and acts as an astringent and tonic. A greater reduction of the powers of the system, is, therefore, necessary for the successful administration of that medicine, than for the sulphate prepared from it; while on the other hand the bark is best adapted to cases in which the vital energies are seriously impaired. If to these variations we add, that when the stomach is irritable, the sulphate may be retained, but the bark thrown up, we have before us all the data necessary to a practical estimate of the relative value of the two medicines, in the present disease; and omitting a further reference to the latter, I proceed to speak of the *curative* power of the former.

1. *Omission of Preparatory Treatment.*—At the outset it may be asked, whether the sulphate of quinine will cure intermittent fever without the preparatory treatment which has been recommended? The answer must be that it will; for in the south, it has of late, been frequently administered, as the first medicine, and found successful. This may seem incredible to those, who, adhering rigorously to old ideas, regard evacuation, revulsion, and time, as curative; and the sulphate as a tonic, maintaining and carrying on what they had commenced; but those who see in that medicine, a power of establishing in the system a peculiar action, incompatible with the febrile, will have little difficulty in believing the report that it has often succeeded, without preparative treatment. Regarding the morbid state of the secretions, as the effect and not the cause of the disease, they will consistently suppose, that the best corrective for that state must be the agent which can supersede the febrile action by one of its own. Nevertheless, I believe the preliminary treatment, which has been pointed out, generally advisable, and in many cases indispensable. This remark, however, applies chiefly to the early stages of the disease; for in relapses, no treatment preparatory to the administration of the sulphate, is in general required.

2. *Times of Administration.*—In traversing the Valley, I have met with respectable physicians who prefer to administer the sulphate in the decline of the paroxysm; others who choose the whole period of apyrexia; others who give it shortly before the access of the cold stage; others who exhibit it indiscriminately through the paroxysm and the intermission; and all referred to experience as the test of their preference. It seems to result from this diversity, that it signifies but little, when the medicine is given, provided the system be brought and kept under its impress. That a liberal dose on the decline of the paroxysm, may promote the sweating which then comes on spontaneously, there is no doubt; but it must be borne in mind, that the effects of such a dose upon the constitution may pass away, before the hour for the next paroxysm. The object in view, is to secure the impression of the medicine on the general system, at the time when the cold stage would form. To this end, it would seem important to make a liberal exhibition immediately before that event; and many who pursue this practice

regard all that is previously administered, as useless; others, however, apprehend bad effects *in* the approaching paroxysm, from this administration. Relying on my own experience and that of many others, I would say, that whatever previous administration may have been made, the important period of exhibition *is* a short time before the access of the paroxysm — for then is the struggle, to speak figuratively, between the medicine and the disease. The peculiar effects of this agent are temporary, and not like those of digitalis, on the heart, or of calomel on the mouth, cumulative. Nevertheless, evidence is not wanting to show, that the disease may be arrested, without a special exhibition at that time; nor is their a want of proof that it is safe to give the medicine in the hot stage; especially if bloodletting and purging have preceded its employment.

3. *Doses.*—As to the doses in which the medicine should be given, I have also found much diversity of opinion and practice. On the whole the people, and a majority of our physicians, administer one or two grain doses, at short intervals, and the practice is undoubtedly, on the main, successful. In protracted cases this mode of exhibition may be the best; but in the early stages, and when the object is (as it should be) promptly to arrest the disease, occasional large doses are, I think, to be preferred. In a quotidian, for example, five or ten grains on the decline of the Fever; a similar dose six or eight hours afterward, and a third before the access, seem to me the best; and the practice is sustained by the experience of many of our most eminent physicians.

4. *Required amount.* — Much has been said on the quantity necessary to arrest a simple intermittent. That it is often given in much larger portions than have just been named, is quite certain. But I have met with many physicians who regard such an exhibition as prodigal, and declare that the characteristic effect is produced, if at all, by a much smaller amount. There is a reality in this, as it respects simple intermittents; and where there is no reason to fear a lurking malignity, it will be safe to rest upon a more limited administration.

5. *Adjuvants.* — In regard to the adjuvants, to which recourse may be advantageously had, I may say, that if the symptoms should indicate a considerable degree of biliary derangement, calomel may be advantageously combined with the sulphate, and that, when it is given, while the excitement of the system is yet considerable, or when administered during the hot stage, the nitrate of potash may be beneficially united with it, in the proportion of four grains to one; or, instead of that refrigerant salt, one grain of ipecac may be used. But the most important adjuvant is opium, on the use of which I must dwell for a moment. Of the value of this medicine, when administered before the access of the paroxysm, the profession has long had a just appreciation, though many of our physicians employ it so sparingly as to obtain but imperfect results. With my preceptor, Dr. William Goforth, long among the most popular physicians of the infant settlements of Kentucky and Ohio, it was a favorite prescription; and in his practice, as well as my own subsequently, I often saw its liberal administration in a solid

form, an hour or two before the expected paroxysm, so as to bring the patient into a state of narcotism before the signs of chilliness began to show themselves, productive of the best effects.

The analogies between opium, and especially between the sulphate of morphia and the sulphate of quinine, would lead us to expect such a result. At the present time, the practitioners of this country very generally unite opium with the quinine, which they administer before the paroxyms, but in very different quantities. Of those who are in the habit of giving large doses, I may mention Doctors Henry and Merriman, of Springfield, Illinois, who give from three to six grains of solid opium, with about the same quantity of sulphate of quinine, just before the chill, and find, as they assured me, a more certain arrest of the paroxysm than when they omit the opium and double or treble the dose of quinine. If an apoplectic tendency should be suspected, this practice, of course, would be improper; while in the case of an intemperate man it would be almost indispensable.

6. *Continuance of the Treatment.*—As to the length of time the medicine should be continued, it is impossible to speak definitely, without being dogmatical. And here I must state, that many persons, including some physicians, cherish a *quasi* prejudice against this medicine, on the ground that, although it will promptly arrest the paroxysms of an intermittent, they are apt to return. In short, that relapses are frequent under its use. My inquiries lead me to adopt this opinion. As already said, the anti-periodic influence of the quinine is temporary, and when it has passed away, the system remaining enervated, slight causes will occasion a relapse. This is no objection, however, to the admitted benefits of the medicine, in breaking up the morbid catenation; with which effects, in many instances, the exhibition of the medicine ceases. If its administration were continued longer, many relapses would be prevented. The indication, however, is not precisely the same after as before the arrest of the paroxysms. Before they are arrested, the object is to establish in the system that peculiar action which is incompatible with their reproduction; but after they are interrupted, the object is not only to keep up the same action, but to restore the strength, and reëstablish the functions; to which ends the bark, from its tonic and astringent properties, not less than its anti-periodic elements, is much better adapted. The right practice then is, after having broken in upon the paroxysms with the sulphate, to resort to the bark, and continue its use until the atmosphere of early autumn has passed away, and, in cases showing great tendency to relapse, throughout the succeeding winter. In general, a drachm of the powder taken before each meal will be sufficient.

Dismissing the bark and its preparations as remedies in simple intermittent fever, we must now turn our attention to others, on which so much need not be said.

V. Vegetable Bitters.—Many of our native bitters have been more or less extensively used to arrest the paroxysms of intermittent fever. The favorites are, or have been, the bark of the *Cornus Florida*, or dogwood; *Liriodendron tulipifera*, or yellow poplar; *Prunus Virginiana*, or wild cherry tree, and the herbs *Eupatorium perfoliatum*, or thoroughwort, and *Sabbatia angularis* (formerly *Chironia ang.*), or American centaury. As it was an old professional opinion that the superior efficacy of the cinchona bark, over other bitters, arose from the union of an astringent principle, it has been customary to combine, with the bark of the trees just mentioned, a quantity of oak or some other astringent bark, and to render the whole stimulating with wine or whisky; frequently, indeed, to administer them in the form of tincture.

I cannot doubt that these bitters have often arrested the paroxysms of intermittent fever, but it has generally been after the diseases had continued for some time, and were kept up partly by debility, and partly by the habit of recurrence. Hence the proper time for using them is the period of restoration, after the paroxysms have been interrupted by other means. Of the whole, the dogwood has had most reputation; and, after the alleged discovery of a peculiar alkaloid principle in it (cornine), supposed to be analogous to quinine, considerable expectation was excited in its favor. I have not myself used it, nor have I been able to collect any experience worth detailing. The testimony in favor of the eupatorium is, I think, fuller than that bearing on the dogwood. A number of physicians have assured me, that they had found it a successful anti-periodic; but no one has spoken so unequivocally as Dr. Herbert, of Gallipolis, Ohio. His method is to make a saturated tincture, with alcohol, of the leaves and flowers of the plant, and administer it, at short intervals, in drachm doses. If the accounts which I have received are to be relied upon, it seems probable that this herb contains a peculiar principle, resembling quinine in its effects upon the body. And here I cannot refrain from observing, that in a country of such vast extent as ours, many parts of which, from their topographical structure, must forever remain subject to intermittent fever, it should be regarded as a duty of patriotism and humanity to test, by exhibition and analysis, such of our indigenous plants as in their sensible qualities bear any resemblance to the cinchona. He who should discover, in our country, a substitute for the bark, out of which the sulphate of quinine is manufactured, would be honored as a benefactor.

VI. Arsenious Acid.— The extent to which this medicine was employed in the intermittent fever of the interior, was greater before than since the introduction of the sulphate of quinine. Its minute dose commended it to those who disrelished bulky portions of cinchona bark. Since the use of the sulphate became general, it is sometimes combined with that medicine, and there seems to be no objection, chemical or therapeutic, to the union. The arsenious acid has not commonly been administered in the first stages of our intermittents; and, it has seemed to me, perhaps, without sufficient reason, as better adapted to cases a little prolonged. It is quite certain that it has the power of arresting the paroxysms, though not so promptly as the sulphate of quinine. As its effects, however, are more lasting, it is, perhaps, not so often followed by relapses. Many of our physicians administer the solution of arsenite of potash (Fowler's solution); but I have generally given it in substance. The following formula is that which I have been accustomed to employ:

℞. Arsenious acid, - - - - - - - grs. j.
Finely powdered opium, - - - grs. iv.

Mix intimately, and divide into sixteen pills.

Three or four of these pills, in the course of twenty-four hours, are as much as can be long borne. If the disease should not yield, by the time the stomach becomes irritable, with some degree of epigastric tenderness, or the face exhibits an incipient œdema, it is not advisable to continue the medicine any longer. Sixteen grains of sulphate of quinine, added to this formula, will make it as effective in obstinate agues, as any other remedy with which I am acquainted.

SECTION III.

INFLAMMATORY INTERMITTENTS.

I. Diagnosis and Pathology. — Every autumn, in all parts of the Valley, though least in the southern, we see inflammatory mixed up with simple intermittents, but they are far less in number. In this respect, however, different years vary from each other. Thus, in some seasons, there will be very few — in others a large number. There is in such years a phlogistic, atmospheric constitution, giving to almost every form of disease an inflammatory character. The modification of intermittent fever we are now studying, presents us with tension of the pulse, a prolonged hot stage, and an imperfect intermission. But the best diagnostic symptoms, are those which indicate an inflammation of some organ, generally one of the following:

1. *The Spleen.* — The morbid effects of every variety of intermittent fever on the spleen, are well known to all physicians. In every one of the ten winters that I was connected with the University of Louisville, and delivered clinical instruction in the hospital of that city, I met with lesions of the capsule of the spleen, produced by inflammation. They were generally spots or bands of false membrane. Most of the subjects in which they were found had been boatmen; a class who are exceedingly liable to intermittent fever. From these and other facts, I am convinced that splenitis is frequently present in that disease. It is not, however, the cause, but a contingent of the fever; for the symptoms of splenitis are not present at the commencement of any case, as far as I have seen; and numerous cases run through a long course without their occurrence.

The signs of splenitis are tenderness and pain, on pressure over the epigastric and left hypochondriac regions; especially when the fingers are pushed upward behind the cartilages of the ribs; a slight cough, without expectoration, resulting apparently from an extension of the inflammation to the diaphragm; and when the organ is swollen, a dull sound, under percussion, over the false ribs. When this dullness exists, the case may be distinguished from pneumonia by auscultation, which reveals the normal respiratory murmur, instead of the crepitus, which characterizes that form of pulmonary disease. When splenitis is present, moreover, the intermissions of the Fever are imperfect, although the chills and even a shake may continue to recur. A still further diagnostic sign is to be found in the failure of the sulphate of quinine to arrest the paroxysms of the Fever. It is not my intention to go further into the history of this inflammation at this time, as the disorders of the spleen, produced by autumnal fever, must be made the subject of a separate article.

2. *The Stomach.* — The mucous membrane of the stomach is occasionally the seat of inflammation in these intermittents. But we must not regard every instance of irritable stomach as the result of gastritis; for nausea and vomiting may occur independently of inflammation. This is proved by their yielding, in some cases, to an emetic, and in others to a liberal administration of opium and the sulphate of quinine, or even to the bark in substance. I was assured by Dr. Picket, formerly of Indiana, but now of Mississippi, that he had often seen his preceptor, the late enterprising and lamented Dr. Perrine, who once practiced in the former state, compel his patients, who had irritable stomachs, to hold their hands on their mouths and swallow, a second time, the large doses of bark which, before the introduction of the sulphate of quinine, he was accustomed to administer. Nevertheless, that gastritis *is* sometimes associated with intermittent fever, may be regarded as unquestionable; though the discriminating diagnosis between it and mere morbid sensibility of the organ, may be difficult. Fullness, and great tenderness under pressure and percussion, with nausea and embarrassment in the descent of the diaphragm, would undoubtedly require us to regard the Fever as complicated with gastritis, especially if these symptoms subsisted through an imperfect apyrexia. That this inflammation may often extend to the duodenum, giving a real gastro-enteritis is, at least, extremely probable.

3. *The Liver.* — Although less frequently the seat of inflammation than the spleen, the liver is perhaps as often, or more frequently, inflamed, than the stomach. The hypochondriac tenderness, hacking cough, irritable stomach, and sallow or jaundiced eyes, skin, and urine, will sufficiently disclose the existence of hepatitis.

These appear to be the legitimate or characteristic inflammations accompanying this variety of intermittent fever; but there are others, of a contingent or accidental kind, which must not be overlooked.

4. *The Lungs.* — A sudden change of weather may develop pulmonary inflammation in connection with intermittent fever. This will be indicated by cough, dyspnœa, pain, and the ordinary auscultic signs.

5. *The Brain.* — If this organ be large, and the chest and neck of the patient short; or if he has had his mind or passions strongly excited before the onset of the Fever; or should he be subjected to mental perturbations, after it has begun, some form of cerebritis may be set up. But we must not regard every case of headache, sense of fullness, and delirium, as evidence of inflammation, for such symptoms are not uncommon, during the paroxysm of

the simplest intermittent. The acuteness of the symptoms, their increase under succussion and depression of the head to the level of the body, and their subsistence, though in a diminished degree, through the period of intermission, will in general justify the conclusion that inflammation exists. If with these symptoms we have variableness in the pulse, a certain degree of altered expression, with redness of the eyes, and the patient, without being prone to disturbance of mind, under ordinary attacks of fever, is acutely delirious, the existence of inflammation would no longer be a matter of doubt.

The reactive effect of a supervening inflammation, on the Fever, is to increase its acuteness, prevent a full apyrexia, and transform it into a remittent; which may be distinguished from an original attack of that kind, by the history of its commencement, and by the existing signs of an actual inflammation, in some organ. If the inflammation should run high, and, especially, if it should have been induced by an external cause, acting on the lungs or brain, the Fever may assume a continued type; and pass for an original phlegmasia. The inflammation which attacks the spleen, stomach, or liver, above all, the spleen, appears to depend on the same remote cause with the Fever; and does not change the type from intermittent to remittent, to the same extent with the cerebral or pulmonary inflammation.

II. Treatment. — If in pursuing a routine practice, the sulphate of quinine be indiscriminately administered, when there is a prevalent atmospheric constitution of an inflammatory character, many cases will be aggravated by it, and in others it will fail. Venesection should always precede its exhibition in such cases; when, the febrile excitement being reduced, the medicine will produce its characteristic anti-periodic effects.

If, however, one of the organs which have been mentioned, or any other, should be inflamed, a more extended anti-phlogistic treatment will be required to prepare the system for the use of quinine.

Of these inflammations, splenitis yields most readily; a copious bleeding, followed in some cases with cupping, or a blister, with the cathartics employed in simple intermittents, will in most cases prepare the system of the patient for a successful administration of the sulphate.

An associated gastritis gives greater difficulty, and must be more completely removed than splenitis, before the quinine is administered. The lancet is, of course, indispensable; and subsequent leeching or cupping on the epigastrium, will be followed by more obvious benefits than in splenitis. Subsequently a blister to the same region will be of great service. In this inflammation calomel is demanded; and will be found more efficacious in large occasional, than in small and repeated doses. The following formula will be found convenient —

℞ Calomel,
Powdered Gum Arabic, } a a gr. x, mix.
White Sugar.

To be administered every four hours. The bowels should be opened with injections; and all drastic cathartics avoided, together with tartarized antimony and other emetic medicines. As soon as the inflammation and fever begin to abate, one grain of powdered opium may be added to the calomel; after which, the quinine may be administered, as in simple intermittents.

When the Fever is complicated with hepatitis, general and topical bleeding will be proper; but their effects, on the whole, will be less satisfactory, than in splenitis, gastritis, or gastro-enteritis. Antimonials, unless there should be a high degree of sympathetic irritability of the stomach, are not objectionable; and free purging will prove useful. The regular administration of calomel should, however, be the main reliance. Five grain doses may be given every two or four hours, according to the intensity of the symptoms; and continued till they abate, or a salivation is induced. When the inflammation has begun to yield, quinine may be mingled with the calomel, and will soon arrest the paroxysms. The hepatitis, however, may remain in a subacute form, or the liver may fall into a torpid condition and give a tardy convalescence. When this happens, one of the following pills, taken every six hours, will generally complete the cure—

℞. Extract of Taraxacum, - - - - - - ʒij.
Mercurial Blue Mass, - - - - - - ʒss.
Sulphate of Quinine, - - - - - - - ʒss.

Mix and make into thirty pills.

The nitro-muriatic bath to the feet and right hypocondrium, will, also, be found serviceable in such cases.

Should the inflammation be determined upon the lungs, the lancet will be indispensable; to which, if pleuritic pain exist, topical bloodletting, and a subsequent blister, may be added. Drastic cathartics will be of little value; but emetic medicines, even to full vomiting, will be proper. Tartarized antimony in large doses may be given, or the squill, in liberal quantities, substituted for it. As the inflammation recedes, the sulphate of quinine may be combined with either of the latter medicines, or with any other sedative expectorant.

It is proper, here, to add a word of caution in regard to affections of the lungs in connection with intermittent fever. It is well known, that individuals who have experienced attacks of the Fever in autumn, are liable, through the following winter, to relapse; and the change of weather, or exposure, which reproduces the intermittent, may generate an inflammation of the lungs. But in the south, or in very unhealthy places, that which seems to be an inflammation is often a mere congestion or sanguineous engorgement, returning with the febrile paroxysm. In this pathological condition, which may be recognized by the absence of tension in the pulse, and by the intermittent tendency of the pulmonary symptoms, the powers of the system fail under copious bloodletting; but full vomiting, with the subsequent use of the following compound, may be of great service—

℞. Tartarized Antimony, - - - grs. viii.
Opium, - - - - - - - - grs. iv.
Sulphate of Quinine, - - - grs. xx.

Mix and divide into eight pills.

One to be given every two or four hours. In addition, a large blister to the thorax may be applied with advantage.

If the inflammation be seated within the cranium, a freer use of the lancet should be made, than if seated below the diaphragm. The appearance of the blood will assist in the diagnosis of the case, and aid in a decision as to the repetition of the bleeding. The usual means of subduing cerebritis, such as cupping, elevation of the head, and cold or subtepid effusions, must of course be employed. Of medicines, nothing is equal to copious purging with calomel and jalap; or with calomel and injections, if the stomach should be too irritable to retain the former. The diversion thus created from the brain, in connection with the evacuation of the contents of the lower bowels, will be attended with the best effects. Counter irritation with blisters, should the inflammation not speedily yield, will be proper. When an abatement sufficient to justify it has been effected, the sulphate of quinine must be administered; but opium, except in minute quantities, or under unmistakable signs of constitutional irritability, should not be administered. In the complication we are now studying, the disease is, as it were, transformed from an intermittent into a continued inflammatory fever; and when the local affection is removed, there may not be a return of the paroxysms — if, however, they should return, the sulphate of quinine must be administered, as for a simple intermittent.

III. Recapitulation. — I have said all that seems necessary on the history and treatment of our simple and inflammatory intermittents, in their early stages; but they often assume a chronic form, and occasion more perplexity to the physician than in their earlier periods. Hence our study of them is not finished; but, as malignant intermittents and remittents of every kind occasionally terminate in protracted and relapsing intermittents, I propose to include the whole under one head, after we have studied all the varieties in their early stages.

But before entering on the next variety, that I may be understood as to certain pathological and therapeutic principles which will be carried through the whole, it seems advisable, that I should here present them in the form of a recapitulation of the two sections through which we have just passed.

1. The remote cause of intermittent fever makes its impression primarily upon the nervous system, producing constitutional depression and irritation, followed by febrile reaction.

2. The reaction lasts less than a day, and is succeeded by a period of comparative health; but from the peculiar relation between the remote cause and the living system, the depression and irritation recur, and are again followed by reaction.

3. There is no primary inflammation, nor is inflammation a necessary condition of the existence of the Fever; yet it often arises with or supervenes on the Fever; the spleen being the organ oftenest affected, and frequently suffering from congestion, and perhaps, also, from modes of morbid action not yet understood.

4. In certain seasons, and in the cooler climates, intermittent fever mani-

fests a higher tone of phlogistic diathesis than in others, although no organ may be inflamed.

5. Intermittent fever is a disease of a specific character, as much as scarlatina, hydrophobia, or scrofula.

6. The bark, and the salts formed out of its alkaloids, are the true remedy — the antidote — the specific. But they are not infallible; and, in many cases, may be aided by certain adjuvants, of which the most important is opium.

7. The object of all the other treatment is to prepare and keep the system in a proper condition for the action of the specific.

8. There are other medicines which may be regarded as imperfect specifics, of which the most important are arsenious acid, opium, piperine, and the active principle of the *eupatorium perfoliatum*.

9. When the bark or its preparations fail, the failure is generally referable to one of two causes — the continued action of the agent which produced the Fever, or an obscure inflammation of some organ.

CHAPTER VI.

MALIGNANT INTERMITTENT FEVER.

SECTION I.

GENERAL HISTORY.

I shall comprehend, under the term malignant intermittents, all the cases known to the Valley, which are not referable to the two preceding heads. The members of this group, in their symptoms, differ much more widely from each other than those of the preceding groups. They are all, however, marked with a common character of anomaly or irregularity. The harmony of symptoms, both cotemporary and consecutive, observable in the other groups, is here wanting; or if displayed at the beginning of a case, is lost in its progress. They are still further characterized, in their obvious aspects, by a predominance of the cold stage over the hot; and by a downward manifestation of the vital forces and functions, not to be mistaken by the most careless observer. They agree, moreover, in occurring chiefly in the epidemic period of the year, and in the localities most subject to autumnal fever — those which are branded as most insalubrious; finally, they concur in a strong tendency to an early and fatal termination, when not arrested by art.

In different parts of the Valley, they are known, by the profession, under the general appellation of congestive or malignant; and, in their sub-varieties, by the terms irregular, misplaced, soporose, or algid, according to the prevalence, in particular cases, of this or that anomaly.

I need scarcely say that this variety of intermittents never constitutes an entire epidemic. It is mixed up with the other varieties; and, in most localities, the proportion which these cases really bear to the others, is much smaller than is generally supposed, at least by the people. Two or three circumstances have contributed to swell the catalogue of cases beyond the truth. *First.* When a case of this kind proves fatal, the neighborhood in which it happens is thrown into a state of alarm, and every attack of intermittent which occurs, is liable to be pronounced of the same kind—thus, by a stroke of the tongue, simple intermittents are transmuted into malignants. *Second.* There are empirics who are willing to profit by this delusion of the people, or even to excite it, and therefore apply the dreaded epithet, congestive, to ordinary cases, for the purpose of magnifying their skill in saving life. *Third.* Physicians, the most skillful and conscientious, are often at a loss to say whether there may not be a lurking malignity in certain cases; and, therefore, prudently speak of them, and prescribe for them, as if they were really dangerous; when, in fact, if let alone, they might take the course of common intermittents.

The regions of the Valley most infested with the fevers of this order, as far as I am now prepared to state, are, *First.* The level portions of Alabama, Mississippi, and Louisiana, including the zone of estuaries around the Gulf. *Second.* The southern shore of Lake Michigan, from Chicago round to the St. Joseph River, and of Lake St. Clair and Lake Erie, from Lake Huron to Lake Ontario, near the estuaries of the creeks and rivers. The intervening region and the country off to the west of Lake Michigan, are, however, not exempt; but the proportion of cases, with the exception of a few limited localities, is much less.

In the early settlement of the states on the Ohio River, examples of this fever now and then occurred, and such is still the case; but neither in early nor later times were they numerous, except along the lower third part of that river; where they seem to have existed in considerable numbers from the beginning of settlement. Relying on the answers to my questions, concerning the increase or decrease of this fever in the regions where it prevails most, I may say that, in latter years, it has been increasing, and that this increase appears to date from the visitation of the Epidemic Cholera, in 1832–4. Still, from the short time that most of the physicians of the south remain in practice, it is difficult to gather up correct data on this subject. That the cholera-atmosphere *may* have had this effect must be admitted. It was very perceptible in the vicinity of Cincinnati, for two or three years after that visitation; and the history of epidemics, in all countries and ages of the world, coincides with this alleged effect.

No class of persons is exempt from this form of intermittent fever; but both sexes and all ages are liable; and, as far as I know, equally so, under equal exposure to exciting causes.

After these general introductory remarks, we must proceed to take a closer view of this difficult subject, beginning with its symptoms.

SECTION II.

SYMPTOMATOLOGY.

There is not perhaps in the whole range of symptomatology, a more difficult task than that of making a graphical presentation of the symptoms, which accompany and characterize our malignant intermittent fevers. This results from several causes: *First.* Their number; all the functions being morbid. *Second.* Their simultaneous occurrence; as if the whole of the organism had been affected by the direct action of the remote cause at the same time. *Third.* The suddenness of their occurrence on the access of the paroxysm; presenting, in a single hour, a transition from a state apparently bordering on health, to one of impending dissolution. *Fourth.* The deep involvement of one great organ in one case — of a different one in another, and a consequent modification of the symptoms. Compared in the diversity of their phenomena with the most malignant cases of scarlatina, typhus gravior, or epidemic cholera, they are decidedly more difficult to portray in a methodical and faithful manner than either. Moreover, their malignity sometimes shows itself by the slightest possible anomaly. Thus a partial numbness, or a coldness of the great toes, instead of a regular chill, or a disposition to sleep at the access of the paroxysm, may be all that suggests anything more than the most harmless intermittent. Hence they stand connected, on the one hand, with a simple ague; while, on the other, they graduate into the malignant remittent type, in such a manner that a separate description would scarcely be worth the trouble, were it not that a series of morbid states, however intimately catenated, must be studied in its links, before it can be comprehended in its entireness.

By far the greater number of cases begin as regular intermittents, with a cold fit too slight to excite more than a moderate shivering; such, for example, as ushers in a simple remittent. The cold stage, is not followed, however, by the well developed and prolonged hot stage of that variety of fever; but by one so inconsiderable, that the patient in many cases is soon upon his feet, and often resumes his business till the next day, or the day after that. If nothing should have been done, the second paroxysm will be more severe; his coldness will be greater and more prolonged, yet not productive of a shake; he may have a considerable degree of drowsiness, or dyspnœa, with a sense of thoracic oppression; his stomach may become irritable, with a sense of epigastric sinking; or some, topical sweating may show itself. To these symptoms, but more slowly than the day before, will succeed a reaction of moderate force, and when it ceases, the patient, if not alarmed, will be again out of bed, and, perhaps, occupied. The third, and even the fourth paroxysm may thus pass away; each, however, presenting an increase of intensity in the symptoms, and a full development of them be reserved for the fifth. But this is rare; and, in the majority of cases, the third fit, not only discloses the danger of the patient, but often proves fatal; or he struggles through it, to die in the next. The disease, however, does not always advance in this gradual manner. Almost every physician, where it prevails extensively, has met with examples of fatal termination in the second, and, sometimes, in the first paroxysm. Still further, cases of the most simple kind, which, through several recurrences, have shown no sign of malignancy, have, under the unadvised operation of an antimonial emetic, or an active saline cathartic, proved fatal in the next paroxysm. When the dangerous or fatal paroxysm comes on, the functions of the whole body seem blighted.

1. That of innervation is blunted and inactive. But little (and no acute) pain is felt in any part of the body; external applications are not much regarded, and even the cuticle, as I have seen, may be torn off, by rough frictions, without attracting the attention of the patient, although neither asleep nor delirious. The organs of special sensation are equally impaired. The intellectual functions, and the feelings, and affections of the mind, are passive; and the expression of the countenance, is vacant, or stupid. In some cases, a considerable degree of delirium supervenes; but in others, the faculties of the mind, almost up to the moment of dissolution, show nothing more than inactivity. Should there be some degree of delirium, the disposition to action will of course be greater. In many cases, however, the patient sinks into a coma, from which it is difficult to arouse him, and into which he immediately relapses, and continues until the paroxysm passes off, or he expires. These of course are the soporose, or apoplectic intermittents of systematic writers.

2. The function of circulation is not less impaired than that of innervation. In comatose cases, the pulse is sometimes slow, full, and irregular; but in the majority of cases, it falls rapidly into a state of great feebleness, becomes extremely frequent, shrinks in volume, and, finally assumes a thready and vermicular character. Before dissolution, it often ceases altogether in the extremities; and has been known to be absent for a considerable length of time, in some cases, which have afterward terminated favorably.

3. The function of respiration is impaired. The frequency and depth of inspirations is reduced; a sense of fullness in the chest is experienced; and sighing, with the restlessness attendant on embarrassed respiration, and an insufficient supply of air, supervene.

4. The digestive functions suffer not less, than those which have been named. The state of the tongue is various. Sometimes contracted and prismatic; but more commonly of its natural breadth and form; generally moist; frequently furred; occasional red at the tip, but oftener, pale, and flabby. The appetite of the patient occasionally continues, in the intermissions, up to the fatal paroxysm; but oftener gives place to nausea and gastric irritability; which, on the access of the fit, may terminate in obsti-

nate vomiting; when he sometimes throws up healthy bile, and now and then a fluid of a blue or greenish blue color. In other cases the fluid ejected is acid. The number of cases in which a dark-colored liquid resembling the black vomit of yellow fever has been discharged, is so few compared with the whole, as scarcely to deserve a recognition; yet in Peoria, Illinois, I saw a patient of Doctor Rouse, who ejected a black liquid from his stomach a few hours before death. The bowels are sometimes torpid and costive; but in many cases there is a watery diarrhœa. Now and then, the matters thrown off have resembled the washings of beef; or water colored with indigo. Discharges of blood are exceedingly rare. Of the condition of the liver and spleen, otherwise than is indicated of the former, by what has just been said of its secretion, nothing special can be recorded. Many patients, however, complain of a sense of fullness and anxiety, through the hypochondriac and epigastric regions, and some, especially of the left side, apparently indicating great engorgement of the spleen; which is doubtless the case, for that organ has sometimes been found in a state of manifest enlargement, immediately after the recovery of the patient.

5. The urinary secretion presents considerable variety. Some physicians have occasionally seen a great secretion of limpid urine, but in the larger number of cases, it is reduced in quantity, and sometimes the secretion nearly suspended.

6. The function of perspiration is, on the other hand, in most instances, greatly augmented — sometimes partial in its extent, more commonly general. The fluid discharged is watery, and may, almost, be seen exuding from the skin, which feels cold, inelastic, and doughy; sometimes it is bloodless and pale, sometimes the extremities will assume a dark red, and the spots on which pressure is made will remain white for a time, indicating capillary stagnation.

7. Lastly, the greatest reduction of energy is, perhaps, in the calorific function. The heat of the extremities, and occasionally of the integuments of the trunk and head, is signally reduced. It seems as if none were developed in the system, and as great exhalation is constantly going on, from the surface, external applications, both potential and actual, designed to raise the temperature of the extremities, very often produce no effect. In the midst of this reduction, the patient will neither shiver nor complain of cold, but on the contrary, if not deeply comatose, may declare that he is burning up within, and call incessantly for water. Every case, however, is not attended with this remarkable loss of heat. Those which manifest it most, must be classed with the algid intermittents of the systematic writers.

A patient in the condition here described, must of course emerge from it in a short time, or die. He who might have the greater part of the symptoms, which, for the purpose of a full narrative, have been detailed, cannot, of course, be extricated. But a majority of them may be present, and yet recovery take place. In no other form of fever could this occur. In this, it results from the periodical and paroxysmal character of the disease. As the violent symptoms attendant on the cold stage of a simple intermittent, give place spontaneously, to those of the hot stage, which, in a few hours, as spontaneously cease, and are followed by a complete intermission; so there is, in malignant intermittents, a tendency to reaction and subsequent intermission; and these will occur in every case, in which the depression has not gone beyond certain limits, nor any vital organ sustained a lesion of structure or function, from which it cannot recover. To this inherent and inalienable property, we must ascribe, as to a *causa sine qua non*, the revival of the organism from its depressed and perverted condition: without it, the physician would neither have ground for hope, nor encouragment to effort.

Nothing is more common, than for medical gentlemen, where the worst cases of this fever prevail, to describe it, as a compound of the cold and hot stages; which, losing their natural relation of sequence, are, to speak paradoxically, present at the same time; the pathological condition of the cold stage, prevailing in some of the functions — of the hot stage, in others; according as the reaction is not, or is, awakened. No exhibition of symptoms, could more impressively declare the extent to which an external cause had violated the laws of the organism. The prognosis of the case, is drawn largely from an analysis of these phenomena. In proportion as the signs of reaction augment, is the prediction in favor of recovery; while, according to their feebleness, and limited extent through the system, is the prophesy of a fatal issue. In a simple intermittent, all the symptoms of the hot stage, arise nearly at the same time, and harmonize with each other, while they contrast strongly, with the equally harmonious, concourse of symptoms, which characterized the cold stage an hour before. In the malignant, both the harmony and the contrast, are replaced, by a discordant assemblage of phenomena, which belong to both stages, and will contrast with neither.

In some cases, an abatement of the coma—which may give place to a considerable degree of intellectual vivacity, with or without delirium, and some flush of the face and eyes—will indicate cerebral reaction, while the other symptoms of depression may remain. In others, the heart may recover its energies, so far as to manifest reaction, and still the capillary circulation may not be restored. The respiration may increase in frequency, but the color and heat of the surface not be improved. The thirst and sense of internal heat may become intense, with augmented epigastric tenderness and febrile heat of the trunk of the body, while the extremities may remain icy-cold. Finally, the exudation from the skin may diminish, a feeling of chilliness with shivering come on, or the temperature of the limbs become warmer, while many internal functions continue depressed.

If it be a fatal paroxysm, either of the soporose or algid kind, even these feeble manifestations of renovated excitement, may not appear. The occurrence of some of them, moreover, is not a guaranty of recovery; for after having lasted for a brief period, they may die away, and death occur, at the very hour, which a too sanguine hope had fixed for a full development of the hot stage. In cases of a less malignant character, some of the phenomena of the cold stage are apt to continue, anomalously, throughout the hot; and the intermission which succeeds, is seldom comfortable or promising; but displays signs of an unhealthy condition of the vital properties, or the lesion of some important organ; giving a melancholy presage of the mortal event, which awaits the access of the succeeding fit. In proportion as the hot stage has been full and intense, and the intermission perfect, is the prospect of safety in the next paroxysm.

Among the anomalies of this most ataxic fever, I may mention what many of my brethren have, occasionally, seen, a transition from the state of collapse to that of healthy function, or the third stage, as it is absurdly called, manifested in an open and equable pulse, diffused and natural heat, a warm perspiration, renovated muscular energies, and sound functions of mind. In these cases the hot stage seems, so to speak, to have run its course in combination with the cold. They resemble those cases of epidemic cholera, which pass from collapse to recovery, without the intervention of the long paroxysm of fever, which in other cases succeeds to the stage of depression.

When a patient has been brought out of a severe paroxysm of this fever, if neglected or improperly treated, he invariably dies in the next; but under judicious management the disease either takes the course of a regular ague, or ceasing altogether, a rapid and favorable convalescence ensues, which is very commonly the case. When, however, any great organ has suffered injury during the paroxysm, the recovery will be impeded; and, even, a relapse may be the consequence. That organ may be the brain, when the intellectual functions will be, to a certain degree, stultified; or the lungs, producing more or less of cough or dyspnœa; or the stomach, which will remain irritable, and incapable of a due performance of its functions; or the bowels — affected with diarrhœa; or the liver, which will mark the system in its own peculiar manner; but of all the organs, the spleen appears to suffer most; and often remains enlarged, and sometimes tender for a considerable period of time. Thus after all the symptoms of the constitutional disease have passed away, those of a local affection may remain.

As illustrative of several parts of the symptomatology through which we have traveled, I will here introduce the following case, which fell under my notice in Springfield, Illinois.

Case. — September 6, 1844, at 10 o'clock in the morning, was invited by Doctor Merriman, to accompany him in a consultation to which he had been called, by one of his brethren. The history of the case, as well as we could make it out, was as follows: — The patient, a robust and hale countryman, not yet of middle age, residing fifteen miles in the country, felt unwell, on the evening of the first instant, while on his way to Springfield, which he reached the next morning. He was then chilly, but kept about the town till noon, when a fever came on. It abated, and in the evening of the second, he had another chill followed by fever. The next day (third), he had perspiration and was much better, in which condition he still found himself on the morning of the fourth. In the afternoon of that day the chill returned, and his hands and feet, with his legs up to his knees, became cold, and continued so, till his death. His stomach on that became irritable, and he vomited, occasionally, for twenty-four hours, that is, till the evening of the fifth. The next morning (sixth), when I saw him, at ten o'clock, he was restless in the extreme; his forehead was warm, but not moist; his face was overspread with a copperish hue; his eyes were suffused and vacant in expression. His hands and wrists were cold and sodden, but scarcely moist; and exhibited the appearance of *post mortem* congestion,—the dark reddish patches becoming, and for some time remaining white from pressure. His feet and legs displayed nearly the same appearance. The trunk of his body had its natural heat. The pulse of the right wrist had ceased; that of the left was feeble, moderately full, tolerably regular, and one hundred and four in a minute. There was no pulse behind either ankle. His carotid arteries beat feebly. The impulse of his heart was weak, and the sounds reduced. On percussing his chest, I found the resonance loud and hollow, even over the region of the spleen. His respiration was a little bronchial. He had frequent sighings, but no cough or hiccup. He had no abdominal tumefaction or tenderness, and no diarrhœa. There was some ragged fur on his tongue, which, with his gums, had a very tolerable cherry-red color. His mind was a little wandering, and he gave some indications of false, visual perceptions.

Four hours after I first saw him, that is at two o'clock P. M., his restlessness had increased; his pulse had become smaller, and beat one hundred and twenty in a minute; the coldness and parboiled condition of his hands, was greater; and his face at times was pallid. His delirium had, also, increased a little; but he tried, as it appeared, to find his pocket, and when questioned, said he wanted tobacco. Some was handed him, which he put into his mouth, and presently, used his handkerchief, in a natural manner. He then lay more quiet, and seemed as though he would sleep. In a short time, he asked for the urinal, and after an unsuccessful effort at urinating, handed it back. I examined, and found that there was no distension of the bladder. He now complained of the irritating applications, which had been made to his legs two hours before. Such was his situation when I left him, at half past three. At four he became somewhat convulsed and suddenly expired. An hour and a half after death, I found his feet strongly flexed, with a knotted contraction of the muscles of his legs, which had continued from the time of his dissolution. A *post mortem* examination was not permitted.

A further illustration of the fatal anomalies presented by our intermittent fever, is afforded by the following narrative, published by myself, several years since. The cases mentioned in it were probably of the kind which should be called apoplectic rather than algid.*

"BURLINGTON is a small village on the Ohio River, in our own state, nearly opposite the mouth of the Great Sandy River, which separates Virginia from Kentucky. A family by the name of Cox, resided one mile below the village, on the north bank of the Ohio River. The shore is high, and exempt both from alluvial accumulations and collections of water; but, on the opposite side of the river, above the mouth of the Big Sandy, there

*Western Journal of the Medical and Physical Sciences (Cincinnati), for July, August, and September, 1835. Page 372.

are several large ponds. The people on both sides of the Ohio, including those of the village of Burlington, were generally affected with intermittent fever. Among the rest, Mr. Cox and every member of his family, amounting in all to eight persons, were taken down. He, himself, in the course of the disease, was seized with convulsions and delirium, of which he died. One of the children, laboring under the fever, became affected with symptoms of epidemic cholera, and died. Another, laboring under the same fever, experienced an attack with convulsions, like the father, which terminated in hemiplegia, from which, however, it has nearly recovered. All these events happened at the same place. Soon afterward the remaining members of the family removed to Cincinnati, and fell under the care of Doctor Ridgley. One of the children, a boy four or five years old, when the Doctor first saw him, appeared to be coming out of the cold stage. He was able to sit up in the bed and converse rationally. But soon after the Doctor left the house, he said he was dying, and in fact expired—having complained of severe pain in his bowels, a symptom which existed in the paroxysm of the preceding day. Not long afterward, a daughter, two or three years older, laboring under the same form of fever, was attacked with convulsions, accompanied with hemiplegia, and after several repetitions, throughout the intervals of which she remained senseless, she expired. Two other children and the mother are recovering. One of these children, according to the statement of the mother, had a paroxysm of the fever, when it was but three days old. Of the two that died in the city, Doctor Ridgley was permitted to examine the body of one only, the boy, but had not an opportunity of inspecting the brain or spinal marrow. The mucous membrane of the stomach and bowels was free from inflammatory lesions. The liver was unusually firm, and of a leaden color. The spleen was dark-colored, engorged, and enlarged.

"The whole family had been treated, before they came to Cincinnati, with the sulphate of quinine, and bloodletting, both general and local, had been omitted. The Doctor and myself are of opinion, that the whole, at first, required the lancet; and suppose that to its omission, and the early and empyrical administration of the sulphate of quinine, the sinister termination of most of them might be fairly attributed."

SECTION III.

PATHOLOGY AND COMPLICATIONS.

I. Pathology.—So much was said in the preceding chapter on the production and pathological character of the first and second stages of autumnal fever, that but little remains to be added here. A malignant paroxysm, is little else than the cold stage of an ordinary intermittent, deepened and prolonged. The innervation is scathed, the circulation is enfeebled; the blood, largely retained from the more external parts, circulates with difficulty, through the internal or visceral system, which is rendered plethoric, and the great organs, as the stomach, spleen, liver, lungs, heart, and brain, are, respectively, liable to pernicious engorgements, or obstructions, greatly increasing the danger. A failure in the function of respiration, in the coöperative action of the brain, and in the projectile power of the heart, combine to diminish the aeration of the blood; which, deteriorated in its constitution, contributes still further to sink the powers of life. This condition of the respiratory function, diminishes the heat of the body, which is moreover reduced by the failure of the calorific function of the skin, from the combined lesions of the nervous and circulatory systems; while the ready transudation, which the relaxed integument permits, of the serous portion of the blood, and the copious exhalation which takes place, accelerate the cooling. Thus the patient dies under the combined influence of depression of the vital forces, and that consequential or accidental engorgement of some great organ, which has procured for this fever the epithet, congestive. Or should a partial reaction occur — should he survive two or three paroxysms, to expire in a fourth or fifth, as occasionally happens — a low inflammation may be superadded to passive hyperæmia in the organs most capable of reaction, while others remain torpid, and perhaps engorged.

II. COMPLICATIONS. — The diathesis which is present in our malignant intermittents, is observed to manifest its influence in several diseases, which, in summer, autumn, or winter, appear where they are endemic.

1. In July, and August, when dysentery prevails, cases occur, and generally prove fatal, which, by the periodical sinking of the vital powers, evince the presence of this condition of the constitution.

2. During the prevalence of epidemic cholera in the south, the operatives on some plantations, died in such numbers, so much in despite of remedies employed in the very first stages, and with such a rapid decline of the powers of life, as to leave no doubt of the presence of the same influence.

3. The same thing has happened in the epidemic erysipelas of the last few years, several instructive examples of which have been detailed to me.

4. This diathesis has likewise been observed to modify yellow fever—giving it a tendency to a periodical type, and rendering the treatment for intermittent fever necessary to the cure of that disease.

5. But the most frequent and formidable of these complications, is that presented by the pneumonias of the south; and, also, on the shores of the Lakes in the north, where numerous cases occur, which the profession too often find unmanageable, by any method of treatment they have been able to devise.

SECTION IV.

TREATMENT IN THE PAROXYSM.

In most instances, the physician, when first called to a case of malignant intermittent, will find the patient in a paroxysm, and his immediate aim will be to produce reaction. For this purpose a great variety of means have been tried; which sufficiently indicates that none of them are very effective. I shall begin with —

I. Evacuants. — 1. *Bloodletting.* — Some of our physicians, on the hypothesis that a malignant intermittent is only the highest grade of gastro-enteritis, have bled for the reduction of inflammation, but no success has attended the practice; on the contrary, if certain things, injurious in that inflammation, were not done after the bleeding, the patient perished.

Others, and a greater number, have bled to promote reaction, by accumulating the excitability of the system. That, in most forms of disease as well as in health, the loss of blood has that effect, seems quite certain. But is it followed by such an improved condition of the vital properties and powers in malignant intermittents? That it frequently is, in simple intermittents, when a severe chill is rather prolonged, has been shown by Doctor Mackintosh,* and the experience of a number of our physicians goes to the same point. But does such an effect follow its use in malignant intermittents, unattended with great congestion of the lungs or brain? To this question a large majority of our physicans give a negative answer. There is a degree on the scale of vital energy, to which the functions often sink in the cold stage of this disease, which renders bloodletting not only inefficient as a means of restoring the exhausted excitability, but causes the patient to sink more rapidly. When the forces of the system are above that grade, when the danger from exhaustion and collapse is not imminent, the loss of blood may favor reaction; but precisely, when assistance is most needed, it generally fails to afford any. It is to the north, in the basin of the Lakes, as might be expected, that the efficacy of this remedy has been most apparent. To the south, so great is the enfeeblement of the heart and arterial system, that reaction will not in general follow.

2. *Emetics.* — It is well known that full and free vomiting is very often followed by an increase of the excitability and sensibility of the stomach; and, through it, of the whole system. Hence emetics, *prima facie,* would seem adapted to this stage of malignant intermittents, and they have, in fact, been often prescribed. But, on the whole, their effects have not been salutary. In cases not very violent, and administered under certain restrictions, they have often, it is true, been followed by early and general reaction; but their sinister effects have greatly limited their use, and deserve to be recorded. *First.* The nausea, protracted when the stomach is torpid, which precedes vomiting, sinks the powers of the system still lower. *Second.* When the vomiting takes place, it becomes, in certain gastric cases, excessive and irrepressible. *Third.* Instead of vomiting the patient, or after having done so, the medicine is apt to turn upon the bowels, and produce a watery diarrhœa, or hypercatharsis, under which the patient sinks. This is especially true of tartar emetic; which, at the same time, reduces the vital forces; and, therefore, over the south generally, is regarded as a most dangerous

*Principles and Practice of Medicine.

medicine in this fever. The objections to ipecac are not so great, and it is, occasionally, employed with advantage. Of the whole class, however, the stimulating salt and mustard emetic, is the least dangerous, the most likely to do good, and the oftenest employed.

3. *Cathartics.*—Hydrogogue cathartics are regarded as inevitably fatal. Doctor Boling, of Montgomery, told me that he had known six patients killed with a solution of epsom salts and tartar. In cases preceded by costiveness, moderate purging, with blue mass or calomel, combined with extract of scammony, the compound extract of colocynth, and other stimulating cathartics, or followed by an infusion of senna, with aromatics, with castor oil, or, as Doctor Ames, of the same place, prefers, the oil of turpentine, is admissible during the paroxysm, and occasionally favors the reaction. But, on the whole, drastic purging is held to be injurious; and the change which has taken place over the west and south, within the last eight or ten years, on this point, has been signal and decisive. But may not large doses of calomel do good? Of course that medicine will not injure the patient by excess of purging; and, *a priori*, it would seem likely to prove beneficial; but experience has not shown it to possess the power which is demanded in these cases; and, although still in general use, the quantity given is much less than formerly, and the reliance on its efficacy is greatly diminished.

We must turn from evacuants to STIMULANTS, considering them under two heads—external and internal. When the vital forces are so reduced that the functions generally fail, and seem likely to cease, a kind of instinct, strengthened by experience, turns the attention of the physician, the friends, and even the patient, if his mental faculties should not be too much impaired, upon something to excite the system. This feeling, not less than observation, has prompted to the use of almost every known means of excitation. I am sorry to say, they have too often proved altogether ineffectual, and sometimes even inert. The susceptibilities of the system are, in many cases, so much diminished, that stimuli produce scarcely any more effect, than if the patient were actually dead. In cases, less deep and dangerous, they do good, by creating excitement—the great object to be accomplished in the paroxysm. The means employed for this purpose may be divided into external and internal.

II. EXTERNAL STIMULANTS.—Frictions with the hand, with woolen clothes, or with brushes; pungent liniments, as those containing ammonia, or oil of turpentine; mustard, rubbed on dry or applied in the form of a sinapisms; a capsicum-bath, blisters, alcohol, and camphorated spirit, to the extremities, epigastrium, or over the spine, are the principal applications. It is a fact that these articles will redden the skin, without increasing its temperature, or raising the sunken powers of the circulation. The patient may even complain of them, and become restless under their action, without having the excitement of his constitution elevated. But in this matter a physician should be on his guard, for friends and nurses, when a patient is extremely ill, are prone to remove from him everything of which he complains, whereby the expected benefit is sometimes lost. The application of sinapisms and blisters to the extremities is often made when the latter are so cold and insensible, that no effect *can* be produced. This is seeming to do something, when *nothing*, in fact, is done. There are two applications which deserve a separate consideration from those we have just enumerated.

1. *Heat.*—In a pathological state, so strikingly characterized by reduction of temperature, nothing seems more natural than the application of caloric, through the *media* of air, liquids, and solids. When we are cold, the approach to a fire speedily warms us, and we look to the same result in a malignant intermittent; but are often disappointed. The reason is obvious. The organized body — living, dying, or dead, is an exceedingly imperfect conductor of caloric; and, when we are suddenly warmed after exposure to cold, being at the same time in health, it is partly because the loss of caloric was superficial, and partly because the applied heat stimulates the calorific function into increased activity, or reaction; whereby caloric is developed in the structures, as well as received by them from without. But in the sunken state of the vital propertithes, is stimulus often fails to reëxcite the calorific function, and all the warming that follows, on our applications, is superficial and temporary. Sometimes, indeed, *none* can be observed, for the great exhalation which is going on from the skin, and which is actually promoted by the more rapid evaporation of the escaping vapor, under the influence of the caloric we apply, tends to prevent any rise of temperature; and this will, especially, be the case when dry heat is applied, and the atmosphere at the same time has access to the surface. Baths, extensive cataplasms, or the application of flannels wrung out of hot fluids, and so covered with oiled silk or India rubber cloth, as to prevent evaporation, are, therefore, the best modes of applying caloric. Nor need their temperature, in these modes, be many degrees, or, indeed, any above the natural heat of the body; as Doctor Edwards* has proved that heat tends to destroy the irritability of the muscular fiber, already greatly reduced in these cases.

I have seen immersion in a general hot bath, made stimulating with mustard, salt, and whisky, fail to produce the least reaction; and have, also, seen the entire body wrapped in blankets, wrung out of a spiritous decoction of bark, equally ineffective, although applied as hot as they could be borne by the hands of the nurses, and evaporation from them prevented.

2. *Cold.* — The gentleman just quoted has shown that cold tends to preserve the irritability of the fiber, and what has that effect may, within certain limits, be presumed to augment it when reduced. The sudden application of cold, moreover, acts strongly on the nerves of the skin, which are endowed with a peculiar or specific sensibility to caloric; if then cold water be thrown upon it, excitation will be the consequence, unless the patient be past reaction; but the effect will, perhaps, be transient, and by continuing the application too long, the loss of caloric, by abstraction, may do harm. Finally, the cold dash tends to reëxcite the languid function of respiration, whereby excitement and heat may be generated. There are three modes, then, in which

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*Influence of Physical Agents.

cold may prove beneficial in these cases. But not to decide anything *a priori*, when we can appeal to experience, let us inquire into the results of this practice.

The Western Journal* contains a paper by Doctor Achilles Whitlocke, of North Alabama, on the cold dash in malignant intermittents, from which I make the following extracts: — "The common practice in this region, is to repeat the affusion, according to circumstances, until general reaction is brought on, which it seldom fails to produce; though like all other remedies, it sometimes falls short of our more sanguine expectations. The administration of this agent in the collapse of fever, so far as I am informed, originated with Doctor Thomas Fearn, of Huntsville, Alabama; whose reputation both as a physician and surgeon, is too well known to the profession in the south, to need my humble testimony. Living in a region of country, where the diseases are generally violent, he resolved, as a dernier resort, on the experiment of cold water, in the stage of collapse, of the disease now under consideration, and his experiment was not fruitless, for in numerous instances, he and his enlightened colleague, Doctor Erskine, have employed it with unprecedented success; and they do not hesitate to recommend it to the profession, as an agent of superior efficacy to any other they have ever employed. They further believe, that, where the susceptibility of impression is not entirely destroyed, and where no vital organ has sustained an irrecoverable injury, the affusion of cold water, will in almost every case, be attended with complete success. To exemplify its effects fully in this malady, I will here detail a few additional cases, which came under my own care and observation, within the last three years."

The Doctor has given the details of four cases in which the practice was successful. I will introduce one as a specimen of the whole:

"On the third of September, 1834, I was called to see a black man, the property of Mr. F., aged thirty-four years, and of good constitution. I found him very restless, with a small, quick pulse of one hundred and thirty-five beats to the minute, and he was bathed in a cold clammy sweat over his whole surface; he complained of great weight in or about the epigastrium, had an insatiable thirst for cold drinks only; his respiration was difficult, and his physiognomy shrunken. I learned from the overseer, that he had had a chill two days previously, and one on the morning of the present day (it was now near night), and had become much worse since the approach of the sweating stage. Fully understanding the case, as I thought, I ordered some cold well-water to be brought, and immediately poured on his naked body about twenty gallons; having finished, the patient was so much relieved as to return to bed without assistance. In a short time, his oppression was removed, the heat of the surface returned, and he fell into a refreshing sleep. His pulse gradually rose, and became open, full, and less frequent, his respiration easy, and general reaction was present when he awoke. Nothing but the free use of quinine and mild laxative was afterward necessary to restore him to his former health."

* For January, February, and March, 1837.

By extensive inquiry, I have found that this practice is not general, especially to the north. Those who have resorted to it, reside chiefly in the south. Their reports conflict with each other. A part have found it beneficial — a part injurious, no reaction having followed. I may say, of a truth, that the majority of our physicians, influenced, perhaps, to some extent by popular aversion and prejudice, have not employed it.

The sudden alternation of hot and cold water, would, perhaps, be more efficacious, than the exclusive use of either. I have not, however, met with any physician who had resorted to this powerful means of restoring lost excitement.

III. Internal Stimulants.—Almost every kind of excitant and narcotico-stimulant, has been administered, internally. In this stage of the paroxysm of malignant intermittent fever, wine, brandy, whisky, and other alcoholic drinks have been liberally given; but the results have not been such as to commend them. They probably act unfavorably upon the brain. The acrid and aromatic stimulants, such as capsicum, and the oils of black pepper, cloves, and cinnamon, are not liable to this objection, and continue to be in general use: an evidence that they have not been found prejudicial; and doubtless they have sometimes proved serviceable. Camphor and ammonia are likewise used, a considerable number of physicians testify in their favor. On the whole, however, opium has, perhaps, been more constantly employed than any other medicine; and appears to be harmless (if not very obviously beneficial), when not contraindicated by the state of the brain. When the bowels are torpid, its use is apochryphal; but if there be watery diarrhœa, by no means, an uncommon complication, its effects are every way precious; to obtain them, however, it must be administered in very large doses. Finally, the sulphate of quinine has been repeatedly and copiously prescribed during the paroxysms; but not, on the whole, with much benefit. Such at least is the result of my inquiries; to which I must add, that quite a number of physicians have, as they think, found it injurious, from its depressing the vital forces still lower.

Stimulating and anodyne enemata have not been omitted; but it seems that when the stomach is insusceptible to the action of medicines, the rectum is nearly in the same condition. When, however, there is diarrhœa, astringent and narcotic injections have done good.

Such are the measures in general use, for establishing reaction, in our malignant intermittents. Their variety is great, and they are, in most cases, applied with that energy, which is characteristic of our physicians; but the results of their employment, have never been encouraging; and, I see no ground of hope, for greater success, from the use of other, untried agents. The difficulty lies in the state of the vital susceptibilities during the paroxysm.

IV. Means of relieving the Internal Organs.—To relieve the organs which are in a state of congestion or incipient inflammation, is the second object. In the majority of cases, the pathological condition is that of congestion only. This condition connects itself with the paroxysm, of which it makes in many cases a momentous element. I propose to speak of the organs, *seriatim*, in which it occurs, beginning with—

1. The Brain. — The affections of this organ, manifest themselves, as we have seen, by two symptoms—drowsiness and delirium—the former being far more common than the latter. All soporose intermittents, may be regarded as of an apoplectic character, and should be treated accordingly. The remedies are of course substantially the same, as for ordinary apoplexy; but the character of the fever, of which this is a mere, but most serious contingent, limits their application, for the vital forces do not admit of their being pushed very far. Of the whole, that most deserving of deep consideration is:

a. Bloodletting.—After the dissemination in this country, more than previously, of Doctor Mackintosh's recommendation of bloodletting as a means of producing speedy reaction, in the more common form of intermittent fever, it became fashionable to resort to the lancet in soporose intermittents; and it seems scarcely admissible to omit it. In fact the most beneficial effects have frequently followed its use—the coma abating and reaction coming on. Nevertheless, it has often failed; the enervation of the circulatory apparatus, which lies at the foundation of the difficulty, being augmented by the loss of blood. The cases in which it has been most beneficial, were such as presented an anatomical and physiological predisposition to apoplexy, with fullness of face, increased heat of the head, and stertorous respiration. In the absence of these symptoms, and the presence of mere coma with palor of the face, its effects have been less beneficial, and sometimes injurious. After venesection, or in cases not seeming to admit of it, cupping over the neck and temples, has been employed with decided advantage.

b. But, perhaps, nothing, taking the whole range of these soporose intermittents, has done more good, than the continued application of cold or subtepid water to the head; while efforts were simultaneously made with hot baths to invite blood into the lower extremities.

c. A sinapism or blister to the nape of the neck, and sometimes to the scalp, has been found serviceable.

d. In these cases the administration of stimulating and drastic purgatives, such as aloes, gamboge, calomel, senna, and the oil of turpentine mixed with castor oil, is beneficial; and in pursuance of the same object—diverting from the brain—irritating injections may be employed.

2. When the congestion is in the heart and lungs, the dyspnœa, with sense of thoracic oppression, is great, and the danger unquestionable. This state may, to a considerable extent, coexist with oppression of the brain, to the production of which it can indeed contribute; but many cases are without coma, and the anxiety and restlessness of the patient is then very great. In this pulmonary obstruction, and congestion of the heart, the physician is often tempted into the use of the lancet; and is sometimes rewarded by the relief of his patient; but, quite as often is disappointed, no relief to the suffering organs being, thereby, procured; while the powers of the general system are sunk still lower by the depletion. In addition to bloodletting, or as a substitute, scarification and cupping, or extensive dry cupping, over the chest may be employed; after which, the parts may be as extensively irritated with sinapisms or blisters. Of internal medicines, ipecac, or that medicine with

opium, or the wine of ipecac with laudanum and ammoniated alcohol, would seem to promise most. I do not know that the inhalation of steam, rendered stimulating with vinegar or aromatics, has been tried; but, *a priori*, it would appear likely to prove beneficial.

3. The stomach may be the chief seat of local irritation and congestion, when incessant vomiting tends still more rapidly to sink the already smitten vital forces. In this condition, large doses of calomel, opium, and capsicum, are most to be relied upon, while epigastric cupping, or strong counter irritation, have been found serviceable.

4. The diarrhœa occasionally present in the malignant paroxysm, may, perhaps, be the sign of a congestive tendency to the intestinal mucous membrane. The prescription just mentioned is proper in such cases; or liberal doses of opium and acetate of lead, with astringent and narcotic injections, may be employed.

5. The liver, undoubtedly, suffers very frequently in this paroxysm, becoming engorged and sometimes perceptibly enlarged. The secretion and excretion of bile are suspended, and, in some instances, bilious appearances manifest themselves in the eyes, the skin, and the urine. Of course, under such circumstances, a liberal administration of calomel or the blue mass, with or without opium, capsicum, or some other stimulant, is never neglected. I do not recollect to have learned that any physician has tried sponging the trunk of the body with a hot and strong nitro-muriatic solution, in such cases; but, as it would be a powerful counter-irritant, and might exert some specific influence on the liver, it seems worthy of a trial.

6. That the spleen is generally engorged in malignant paroxysms, can scarcely be doubted. It sometimes projects beyond the cartilages of the ribs during the paroxysms, and, of all the *sequelæ* of the disease, an enlarged spleen is the most common; almost the only one, indeed, which remains for any considerable time. Of the different congestions, this is, perhaps, the least dangerous; and may even save more important organs from the same pathological condition.* I know of no special treatment directed upon this organ during the paroxysm.

Such are the chief local affections attending the malignant paroxysm, and the most approved means of removing them employed by our physicians. That these local affections often prolong the paroxysm, and increase the difficulty of exciting reaction, must be admitted. It is still more obvious, that they are frequently the immediate cause of death, especially when seated in the brain or lungs. I have spoken of them as simple congestions, but *post mortem* examinations in Europe have demonstrated, that in the malignant intermittents of that continent, traces of inflammation, in all the organs mentioned, have been found; and, therefore, we must conclude that it occurs on this continent. In general, however, the inflammatory action must of necessity be feeble; and cannot be admitted to be the cause of death, in those who die in the first malignant paroxysm. An inflammation

* Doctor Rush.

may commence with the coming on of reaction; and, continuing comparatively dormant, through the intermission, acquire greater intensity in the succeeding fit, notwithstanding the sunken powers of the system. Thus its ravages are most likely to be found, in those who die after several paroxysms. Should the inflammation supervene at an early period, and acquire considerable activity, it changes the diathesis from a malignant to an inflammatory type, and in that way may prove salutary. When signs of inflammation supervene, the remedies appropriate to its particular seat, must be employed to an extent commensurate with its intensity; but the physician should never forget, that he is dealing with a paroxysmal disease; and that he must employ the antiperiodic treatment not less than antiphlogistic.

SECTION V.

TREATMENT IN THE INTERMISSION.

All the medicines required in the intermission, have been enumerated, as portions of the long catalogue, which have been employed, with but little effect, in the paroxysm. The most important are the bark and the sulphate of quinine, opium, calomel, arsenic, and certain aromatics.

I. Bark and the Sulphate of Quinine. — Before the introduction of the sulphate of quinine, the bark, administered in large doses, was found a successful remedy in this variety of fever. I have often seen from two to four ounces, administered in a single intermission; but such quantities were swallowed with reluctance, and sometimes thrown up by the stomach. Under such circumstances, the medicine was often mingled with injections, and effected a cure. Doctor Hays, now of Indiana, who thirty years ago practiced his profession in Chillicothe, Ohio, where malignant intermittents prevailed, has lately informed me, that he often administered four ounces of bark in that way with the happiest effect.

The sulphate of quinine is not, however, obnoxious to these objections; and at the same time is probably more efficient; I shall, therefore, confine what I am about to say, to that preparation.

1. *Time of Exhibition.* — The concurrent experience of our physicians, declares that this medicine is an effectual remedy, in malignant intermittent fever, if properly administered in the intermissions; yet, there are circumstances which frequently interfere with its success; or, to speak more definitely, either occasion or permit a fatal termination. To these circumstances we must now turn our attention.

a. We have already seen, that the sulphate will not produce its specific influence, if administered *in* the paroxysm. Now it sometimes happens in quotidians or double tertians, that the intermission is so short and imperfect, that the medicine cannot make its proper impression on the system.

b. When the hyperæmia, either passive or active, of some great organ, survives the paroxysm, it may prevent the successful administration of the medicine in the intermission.

c. In cases accompanied with gastric irritability, the stomach may refuse to retain a sufficient amount of the medicine, to arrest the paroxysms.

d. The physician may be called in, when the access of the fit is so near, that the recurring debility of the system may be established, before the medicine which he administers can take effect.

e. He may through ignorance, timidity, or a false theory, exhibit the medicine, in insufficient doses.

f. A predisposition to apoplexy, or habitual feebleness of constitution, may render the exhibition ineffectual.

g. Do morbid accumulations in the stomach, ever countervail the beneficial influence of the medicine? It cannot be doubted, that an alterant of any kind, is more effective, if the stomach be empty; but such a condition of the organ as follows the operation of an emetic or cathartic, cannot be regarded as indispensable to the successful action of the sulphate. If patients have died, because of an unprepared state of the stomach when the medicine was given, I cannot doubt, that a still greater number have been lost, by the delay, and the debility occasioned by a course of evacuation from the stomach and bowels, *designed* to prepare them for the reception of the antidote.

The physician who suspects that he is grappling with a malignant intermittent, should be on his guard in reference to such evacuations. He should fully realize the great truth, that antimonial preparations and saline cathartics, are often the immediate, or exciting causes, of a malignant paroxysm; and that cases, apparently, of the simplest character, are often transformed into the most dangerous, by their debilitating influence.

2. *Quantity and Intervals of Exhibition.*—When the sulphate of quinine was first introduced among us, it was given in one or two grain doses, in ordinary intermittents, and, seldom, in more than double that quantity, for the arrest of the most malignant. The periods of exhibition were every two, four, or six hours, according to the apparent gravity of each case. But although such portions might have proved successful in ordinary intermittents, they were soon found to be insufficient for the malignant; and the practice of giving the medicine, in what would once have been regarded as fatal portions, is now almost universal. Yet, even at an early period, a few physicians went far ahead of their brethren; and the late respectable Doctor Perrine, deserves to be named as one who, twenty-five years ago, in the State of Indiana, led the way in this bold medication. To make known the extent to which this medicine is prescribed by many of our physicians; and, also, to show, that in quantities far beyond the limits of ordinary practice, it does not occasion any permanent bad effects, I will mention the doses in which it is given by many of our physicians.

On the southern shore of Lake Erie, Doctor Tilden, of Sandusky, told me he has given forty grains at once; Doctor Manter, and Doctor Howard, of Elyria, sometimes administer half or two thirds of that quantity at a single dose, to be repeated every two hours, through the intermission. These gentlemen practice in the latitude of forty-one degrees and thirty minutes. At Memphis, near the thirty-fifth degree, Doctor Shanks administers the same portions, and has sometimes given twenty grains at once. Between the thirty-third and thirty-second degree, in Mississippi and Alabama, Doctor Yongue has given, in a single intermission, as much as fifty grains, in ten grain doses; Doctor Davis, ten grains every hour, or every other hour; Doctor Dancy, from five to fifteen grains at once, repeated occasionally; Doctor Street, from ten to fifteen grains, in the same way; Doctor English frequently administers from thirty to forty grains in four or six hours; Doctor Echols, in anticipation of a paroxysm, took twenty grains at a single dose. The fit was averted, and perspiration came on, with a slow and full pulse; Doctor Sims often administers it in ten grain doses, frequently repeated; and Doctor Boling regards that dose as rather large, though he has administered fifteen or twenty at once, and knew forty to be taken in one intermission. But the boldest exhibition seems to have been made in Florida, between the thirtieth and twenty-seventh parallels, by some of our army surgeons. The assistant surgeon, Holmes, has administered twenty, fifty, and even eighty grains at once; and surgeon Harney, one of the senior, and most authoritative members of the medical staff of our army, has given from thirty to sixty grains at a dose, and thinks the larger the portion the better. It is probable that so many of our soldiers are, or have been, intemperate, that they can bear, or may even require, larger doses than are demanded in private practice. To these facts, intended to show the upward limit of the sulphate in our Valley, and at the same time its harmlessness in large quantities, I may, in reference to the latter, add the following: A man in Cincinnati, by mistake, took two drachms of the sulphate, without injury; a patient of Doctor Sappington, of Memphis, Tenn., who had a relapsing intermittent, took eighty grains at once instead of taking it in eight doses, as ordered, but was not injured; Doctor Fair, of Montgomery, Ala., has told me of a patient, who took an ounce in three days, and recovered; and Doctor Hiriart, of Plaquemine, Louisiana, knew of an old lady, laboring under an algid intermittent, who took ten grain doses, every two hours, till an ounce was swallowed. No bad effects occurred and she recovered.

But are the large doses which have been mentioned really necessary to arrest the paroxysm of a malignant intermittent? To this question I would reply: *First.* That a majority of our physicians do not resort to such portions, yet claim as much success as those who do; and I know not that their claim is groundless. *Second.* But in very violent and dangerous cases, as the medicine *may* be administered in great doses without any empoisoning effects, it would certainly be prudent to give it liberally.

In ordinary cases, a scruple taken in one intermission, will, I think, according to the experience of our profession, be found sufficient; and with the adjuvants to be presently mentioned, even half that quantity may often answer. But in cases of a threatening character, forty or sixty grains should be given in the same space of time. Whether any advantage is ever derived from going beyond that quantity, is, I suppose, an open question.

Much diversity of opinion and practice exists among us as to the distribution of the medicine through the period of intermission. I need not repeat what was said on this subject, when speaking of simple intermittents. My own mind inclines to large doses, and long intervals; but, whichever may be adopted, the patient's system should be strongly impressed by the medicine, at the time for the recurrence of the paroxysm; and to secure this, a good proportion of what is used should be administered a couple of hours before the end of the intermission. Thus, if a scruple should be the aggregate quantity, one half ought to precede the chill, and whether the other half should be given in ten, five, or two grain doses, is, perhaps, a matter of indifference.

II. OPIUM, or the SULPHATE OF MORPHIA, is in general use as an adjuvant to the sulphate of quinine, in our malignant intermittents. Of its great value no physician of experience, in those diseases, can entertain a doubt. If there be no diarrhœa, however, it is not necessary to administer it throughout the intermission, but reserve it for the last dose of the sulphate, before the approaching chill. The quantity in which it is then given, is often entirely too small, and much better fitted to simple intermittents, in which the susceptibilities of the system are lively, than to those in which they are greatly reduced. In such a state of the system, three or four times as much as would be required in an ordinary ague, is not a *large* dose. I have met with many physicians who had a just appreciation of this state of the system; but with none who carried the practice, logically deducible from it, so far as Doctor Merriman and Doctor Henry, of Springfield, Illinois. It has grown into a settled opinion with those gentlemen, that a moderate quantity of the sulphate, combined with a large quantity of opium, is the very best practice. Hence through the early periods of the intermission, they do little or nothing; but, three or four hours before the chill, administer a bolus of four grains of opium and eight grains of the sulphate, which, as they affirm, scarcely ever fails. Doctor Henry has even found that dose of opium, without the other medicine, successful. Doctor Jayne pursues the same practice, but generally limits the opium to two grains. While I was in Springfield, the next morning after the death of the man whose case is given *page* 762, and who had not been treated on this plan, Doctor Merriman invited me to see one of his own patients. She had labored for several days, apparently, under an ordinary quotidian, and, by the advice of an empiric, had been copiously purged. This brought on a very dangerous paroxysm, from which, however, she recovered, before Doctor Merriman was called in. As it recurred in the morning, he directed that, in the latter part of the night, she should take his ordinary portion of four grains of opium, and eight of sulphate of quinine. At nine, A. M., four hours afterward, I saw her. She had a slight, degree of drowsiness, said she felt comfortable, her eyes were a little red, her pulse was well sustained, and her skin pleasantly warm. The next morning I called again, and learned that the paroxysm had been averted, and she was recovering. Doctor Shanks, of Memphis, has also found opium very valuable, but distributes it throughout the intermission. He has given as high as twenty-four grains in the twenty-four hours, with decided advantage.

Neither my own experience, nor the facts I have been able to collect from others, enable me to decide between opium and the sulphate of morphine, in the treatment of malignant intermittents. The former is, perhaps, the more durable, the latter more coincident with the sulphate of quinine, in its effects. In many cases its limited bulk may render its administration easier than that of opium.

III. Arsenious Acid. — I have met with a few physicians who had combined arsenious acid with the sulphate of quinine, in the treatment of malignant intermittents, and found it beneficial. Whether, in union with opium, the sulphate being omitted, that compound would succeed, is not known. When the approved anti-periodic is scarce, it would certainly be well to give opium and arsenious acid, liberally, throughout the intermission, and the sulphate with opium near its close. In such cases, the arsenic should be used in larger doses than for simple agues. An eighth of a grain, with a grain of opium every two hours, could not be too much.

IV. Piperine and the Oil of Black Pepper have been added to the sulphate of quinine; and many physicians think well of the addition, especially of the latter. I am not aware, that either of them has been relied upon to the exclusion of the sulphate. Capsicum, in doses of two or ten grains, has been combined with the latter; and, in cases of great exhaustion, the union of that local stimulant may give effect to the principal medicine.

V. Calomel is a common adjuvant of the sulphate; and a favorite prescription with some, is a bolus of ten grains of each of those medicines, and a grain of opium every two or three hours; during the intermission, when there is a watery diarrhœa, or signs of engorgement, torpidity, or other derangement of the liver, the use of calomel or the blue mass is certainly indicated; but, in the absence of such symptoms, that medicine does not appear to be required; as it certainly exerts no power as an anti-periodic, whatever may be its value as an anti-phlogistic.

VI. Regimen and Relapses. — Whatever modification of the treatment here detailed may be adopted, I cannot doubt the indispensable necessity of the patient being kept in bed, and restrained from conversation and every kind of occupation, for the purpose of maintaining the warmth and capillary circulation of the skin, and promoting a gentle but sustained diaphoresis. Through the ignorance and restlessness of patients, seen but seldom by their physicians from being scattered over the country, these salutary observances are perpetually violated, and the wisest methods of treatment thereby rendered abortive. Nothing is commoner, than for men to be walking about up to the access of a most dangerous paroxysm. A man, whose case was mentioned to me, stood up and shaved himself only fourteen hours before he expired; and many undress themselves and go to bed, to die before the next day. No sound pathologist would expect to see a patient, who kept on his feet during the intermission of such a disease, preserved from its fatal effects. After having escaped one paroxysm, the necessity for close confinement is less urgent; but, still, before the period for the next, the patient should be warm in bed, and if possible, asleep.

In some cases a relapse may be malignant, when the original attack was simple; of which I saw an example in a patient of Doctor Rouse, Peoria, Illinois:

Case.—Maynard, a citizen of Kaskaskia, in that state, suffered an attack of intermittent fever, from which he had tolerably well recovered, when he set off to Peoria. On the journey he was exposed to a hot sun and relapsed. On the 14th of September, 1844, when Doctor Rouse saw him, in the paroxysm, he had copious vomiting and purging of bile, and was very cold. On the 15th he experienced another paroxysm of the same kind. On the 16th, when I was invited to see him, he was in a third. I found him nearly pulseless, and the force of his heart very feeble. His respiration was bronchial, and attended with a kind of vibratory purring, recognizable both by the hand and ear. His extremities and tongue were cold. The latter was moist, and stained of a dark color, by a fluid, which resembled finely powdered coffee grounds, mixed with mucus, which he brought up by a kind of eructation. His intellectual functions were nearly unimpaired, though he died an hour afterward.

SECTION VI.

CONCLUSION.

I shall conclude the subject of malignant intermittents with the following observations:

I. I have several times used the word collapse, to indicate the state of the system in a very dangerous or fatal paroxysm. Since the year 1832, that term has been associated in the public mind with epidemic cholera, and can scarcely be used without suggesting that disease. In employing it in the history of malignant intermittent fever, it is by no means misapplied; for the failure in the power of the heart, the reduction of animal heat, the stasis of blood in the skin of the extremities, and the *post mortem* spasmodic contraction of the muscles of the extremities, observed in some instances, are so many points of identity in the two diseases. But there are still some others. Thus, as we have seen, the subject of malignant intermittent fever may keep on his feet, and even attend to business, up to the access of the fatal paroxysm, as the victim of cholera is wont to do, while laboring under the diarrhœa, which may be followed by collapse and death in a few hours. Such patients seem alike unconscious of their condition, and incredulous of the predictions of danger. In the final stage, when death is impending, their intellectual functions are often unimpaired, or simply reduced to an aspect of stolidity, while their feelings and emotions are subdued into apathy. Further, these maladies, so constantly fatal when they reach a certain stage, are, even immediately before its arrival, controllable by very simple and nearly the same measures. Finally, cadaveric examinations have disclosed occasional vestiges of inflammation in both, but not of sufficient extent to account for the fatal termination.

There are, however, two striking differences. *First.* The Fever has an indigenous cause, annually reproduced, and is confined to certain localities; but the cholera depends on a cause, which occasionally visits countries distant from those in which it is elaborated. *Second.* The Fever is, essentially, periodical, while the cholera consists of a single paroxysm.

II. The well known fact, that in the midst of many cases of simple intermittent, not proving fatal, although but little shall be done, there may be a few which assume a malignant character, perplexes both physicians and the people. But this trait of character is not peculiar to that fever. It is equally true of yellow fever, cholera, scarlatina, and all other diseases which have an epidemic prevalence. The whole, in this respect, are under one law, which doubtless connects itself in part with diversities of constitution.

CHAPTER VII.

REMITTENT AUTUMNAL FEVER—SIMPLE AND INFLAMMATORY, CONSIDERED TOGETHER.

SECTION I.

SYMPTOMS.

I. Diagnosis.—If we suppose an ague-shake to be reduced to a mere chill, but the subsequent hot stage aggravated and prolonged, we shall form a just conception of the relations, in symptomatology, between intermittent and remittent fever. We have studied the former under two heads, but I propose, in treating of the latter, to blend under one head, all the cases which are not designated as congestive or malignant.

In general, a remittent is preceded by a forming stage of one, two, or three days, in which there is an increasing languor of the muscular system; inefficiency of body and mind; defective perspiration; rigors, sometimes alternating with flashes of heat; a torpid state of the bowels; increased or diminished secretion of bile; a bilious hue of the eyes; loss of appetite, nausea, and in many cases bilious vomitings; a foul and generally white tongue, having sometimes a tint of yellow; in most instances a dull pain in the head and back. After these and various kindred symptoms of debility and perversion, in the different organs of the body, have continued for a while, the rigors are, as it were, concentrated into a chill, which may or may not amount to shivering; the patient now becomes thirsty, or, if so before, the desire is increased; his nausea is generally augmented; his pulse increases in frequency, and his headache grows worse. In a few minutes, or an hour or two, the chilliness ceases, and is succeeded by febrile heat, over the whole surface, but especially in the head, the pain in which, as in the back, becomes more acute; the mouth loses much of its moisture; the white fur on the tongue rapidly augments; the epigastrium becomes tender; the secretion of urine lessens; and the pulse acquires preternatural frequency, force, and fullness: there is also intolerance of hot and confined air; a tendency to deep inspiration, or sighing, and great restlessness. The chill generally occurs between midnight and noon, commonly in the forenoon, and the hot stage, of which I have drawn the character in brief outline, runs on till after midnight, when it begins to abate; and, by morning, the patient is found with greatly diminished heat, and a limited perspiration; his pulse has become slower, and lost its preternatural force; his thirst has diminished, and he is more or less inclined to sleep. Feelings of health, however, are not present; there remains a dull aching of the head and back; the epigastrium is more or less tender, and pressure upon it may excite nausea; in short the patient has not passed into a state of intermission; but returned nearly into the condition which preceded the chill, the day before. After continuing in this state a few hours, an increase of thirst, headache and frequency of the pulse, usher in a second chill, which, instead of being more, is often less violent, than the first; and is soon succeeded by the full development of a hot stage, commonly more intense than the preceding; which is succeeded by a remission, not quite as great as that which followed the first paroxysm. In this manner, the exacerbations and remissions, are repeated daily; the former being sometimes more violent every other day, giving to the case the character of a double tertian.

II. TENDENCIES AND TERMINATIONS. — 1. Mild attacks, in persons of good constitution, even when but little is done to moderate their violence, will, in many cases, terminate by a sort of crisis at some period of the second week, and recovery or a regular intermittent follow.

2. In more violent attacks, it may soon be discovered that some organ is becoming inflamed. The one which is, perhaps, more frequently attacked than any other, is the spleen; but that organ does not always make known its condition; next to it, in the opinion of many, is the liver, of which the inflammation is less obscure in its signs; then come the stomach and duodenum; then the head, and lastly, the lungs. In proportion to the intensity of the inflammation thus awakened, is the danger of the case; and those who perish within the second week, generally die of inflammation of some great organ.

3. Passing beyond the period here mentioned, the disease may lose its acuteness and periodicity, and begin to exhibit typhous symptoms, which may

gradually increase, until a fatal termination occurs at the end of two, three, or four weeks. In this condition a close diagnostic inspection will generally discover some organ in a state of subacute inflammation, and the one, perhaps, the most frequently involved is the brain; but more of this hereafter.

4. In some cases, especially in the south, it is observed, that after a few regular paroxysms, the hands and feet will continue cold through the hot stage, and only recover their heat in the remission; and this, with other symptoms, to be mentioned elsewhere, indicates, to the experienced observer, congestion of some of the great organs, continuing throughout the whole twenty-four hours, and admonishes him, that he has to deal with a lurking malignancy.

5. Far in the north, remittent fever often presents, almost from the beginning, a tendency to the continued type, displaying the characteristics of the synochus of Cullen's Nosology. It is properly called autumnal fever, because it prevails most in that season, and is an equivalent for the true remittent fever of the warmer climates. Nearly the same remark is applicable to this fever when, in the middle latitudes, it appears in the long-cultivated and dryer portions of Tennessee, Kentucky, Western Pennsylvania, and Ohio. Formerly it often abated into an intermittent; latterly, it is apt to degenerate into a continued type.

6. All these tendencies and modes of termination may occur in the same locality, and in the same autumn; but some are more common in one place, others in another. Moreover, in one season, the cases may be generally mild and simple; in another highly inflammatory; in another disposed to assume a typhous character; in another a malignant or congestive type.

SECTION II.

TREATMENT.

The concise history of the symptoms and pathology of simple and inflammatory remittent fever, which I have sketched, belongs to the middle latitudes rather than the northern; where, as we have seen, the tendency to a continued form prevails; or the southern, where the malignant or congestive type most frequently manifests itself. And what I am about to say on the treatment, will apply more aptly to the fever of our temperate climates than any others.

I propose to speak, successively, of the various methods of cure which have been in vogue among us; and, as far as possible, assign the principle on which each was based.

A reference to the times of settlement of the Interior Valley (*Book I, Part III*), will show that, with the exception of the French and Spanish inhabitants around the Gulf of Mexico, and the French and British on the St. Lawrence and the Lakes, nearly all the settlements of the Valley have been made within the present century; it is possible, therefore, to review the plan of treatment from the commencement of western society, which cannot be done in any other part of the world where large masses of population exist.

I. First Treatment in the West. — There never has been a time when our fever was regarded and treated, as a simple inflammatory affection — a mere phlegmasia. In the earliest period of immigration, it was believed to have something in its pathology, which required other agencies than the antiphlogistic, although a portion of that treatment might be requisite. Two facts, especially fixed the attention of the physicians of that day: *First.* The derangements of the biliary function: *Second.* The inherent periodicity of the Fever; and these facts suggested the treatment. The disordered functional action of the liver was to be corrected; the stomach and bowels relieved from their morbid secretions; the arterial excitement reduced until intermissions were obtained; and, then, the bark was to be administered, to prevent the recurrence of the paroxysms, and complete the cure.

For the accomplishment of these ends, the lancet was employed in the more violent cases, especially when signs of inflammation in any organ were present; and blood was drawn several times in certain cases by some physicians. Others, however, scarcely employed the lancet in any; and referring to the admitted fact, that the drawn blood was, in most cases, free from buff, they argued that venesection could do no good, and might do harm, by inducing the typhous state.

Emetics in those days were standing remedies in this fever. The patient generally threw up a liberal quantity of bile, and felt more comfortable after the operation. In many cases they were repeated several times.

Cathartics were in equal, or even greater use, and consisted chiefly of calomel and jalap, or of calomel followed by castor oil, Glauber's salt (*sulphate of soda*), or an infusion of senna, sweetened with manna. A close inspection of the discharges, from the stomach and bowels, was regarded as an indispensable duty at every visit; and the slightest indication of a return to a healthier state of the secretions, was seen with hope and satisfaction.

Tartarized antimony, generally used as an emetic, and often combined with a cathartic medicine, was, also, administered in nauseating doses; sometimes in simple solution, but oftener in combination with saline refrigerants, of which the most reliable were the nitrate of potash, and the acetate of potash, or common saline mixture, formed with sub-carbonate of potash and diluted vinegar, sometimes administered in a state of effervesence. The spirit of nitrous ether was likewise in universal use, and often added to the saline draught. But, Professor Rush, who controlled the medical mind of the whole country more than any other physician has since controlled it, proposed the following recipe, which was almost universally adopted:

℞. Nitrate of potash, - - - - - - -	ʒ j.
Tartarized antimony, - - - - - -	gr. i.
Calomel, - - - - - - - - - - - -	grs. vj.

Triturate together, and divide into six papers.

One of these powders was given every two hours, through the hot stage. They always nauseated, and sometimes produced both vomiting and purging, while the nitre acted as a refrigerant and sedative.

If the calomel thus or otherwise administered, affected the mouth, no regret was felt by the physician, for, in fact, a mercurial action was thought to be curative. It was generally held, that calomel, on the whole, was the most important remedy, inasmuch as it would act on the liver (assumed to be the organ primarily affected), and at the same time arrest the fever, by its influence on the constitution. With these satisfactory reasons for its administration, it was generally continued for such a length of time, that but few patients got through an attack of the Fever without a salivation.

Opium, in connection with sudorifics, was in general use, and after free evacuation from the bowels, through the afternoon and evening, Dover's powder, or the spiritus Mindereri with paregoric, was administered to produce sleep and diaphoresis through the night.

Cupping was seldom practiced, and leeching nearly unknown. But instead of these, blisters were employed, not only to relieve local inflammation, but to subdue the Fever, when no sign of inflammation existed; and, hence, almost every patient had a blistered surface on some part of his body, throughout the whole period of his confinement.

The object of all this treatment, was to prepare the system for the reception of the bark and other tonics. The length of time required to effect what was regarded as the necessary preparation, varied in different cases, but was scarcely ever less than a week. In many respects this method was judicious; and, although I have spoken in the past tense, it still maintains itself (with some modifications), in the confidence of a large portion of our physicians.

II. Advantages and Disadvantages of this Treatment.—The indications proposed to be fulfilled by this treatment, were, on the main, correct; but some received too much, others too little attention, and a part of the means employed acted violently on the system, without superseding the morbid action.

Those who regarded the Fever as arising independently of inflammation, often omitted bloodletting; when, even in the absence of inflammation, there were reasons for employing it; and, on the other hand, they who held to the inflammatory origin of the Fever, placed too much reliance on that remedy. The *true* reason for resorting to the lancet was not perceived; but on this point I shall speak presently.

The exhibition of powerful emetics and cathartics, *before* resorting to the lancet, was wrong, for they would not operate kindly, and their daily repetition sometimes produced gastro-enteritis. The signs for their discontinuance, were a healthier aspect of the tongue, and of the alvine discharges; but, how could they assume a natural appearance, under the daily irritation of drastic medicines? Too much stress was, in fact, laid upon the indication — 'to correct the state of the secretions.' Moreover, many physicians prescribed purging for the purpose of lowering the excitement of the vascular system, when venesection would have accomplished that object much better, and without the risk of exciting mucous irritation in the stomach and bowels.

As calomel is, perhaps, the most efficacious of all antiphlogistic alterants, and, as the liver seemed to be more involved, than any other organ, it was not strange, that physicians should have assumed, that a mercurial action would supersede the Fever; and, therefore, should have administered that medicine both liberally and perseveringly. The curative results of this practice, were seldom satisfactory, however; while its pernicious effects were sometimes of the saddest character.

The extensive blistering which made a part of that treatment, was every way objectionable. It was sometimes resorted to, while the arterial excitement was high, when all the effects obtained, were an increase of that excitement; and an extensively ulcerated surface, which added to the sufferings of the patient, and occasionally became gangrenous.

Lastly, the administration of the bark was deferred too long; though, we must admit, that it cannot be safely administered, at as early a period of the Fever, as the sulphate of quinine.

We come now to speak of curative plans, carved, as it were, out of that which has been discussed. Methods founded respectively, on a single idea; and, therefore, commended to us by their simplicity.

III. Treatment as for Gastro-enteritis.—The fascinating simplifications of Broussais, could not fail to meet with advocates among us; but they have never amounted to more than a respectable minority. The assumption, that remittent autumnal fever is but a primary gastro-enteritis, had the appearance of a pathological discovery; and the proposed treatment was acceptable to all, both physicians and patients, who had become tired of the polypharmacy, and the uncertain results, of the prevailing method. To withhold emetics and cathartics, opium, stimulants, and food; to give demulcent and acidulated drinks; to use the lancet in some cases, and cup or leech the epigastrium in all, was at once easy in practice, and captivating in promise. In cases which were, really, attended with mucous inflammation, this method was beneficial; and, its adoption by a number of our physicians, exerted a salutary influence on the rest, by restraining them from the *excessive* administration of tartar emetic, calomel, and drastic cathartics. Without having, therefore, superseded, it has modified the older method. Two or three things have, perhaps, contributed to limit its more general adoption. *First.* The extreme difficulty of adequate, topical bleeding, in the country, to which most cases of the Fever belong. *Second.* The desire of our people for strong measures. *Third.* The general propensity in our physicians to employ them; that is, to be doing a great deal.

IV. The Purging Practice.—At all times, and with all our physicians (except those who adopted the opinions of Broussais), purging, as we have seen, has been an important part of our *methodus medendi;* but it required a peculiar hypothesis, to resolve the *whole* treatment into that operation. This was at length supplied, in congestion of the portal circle and the vena cava ascendens. The removal of this congestion constituted the sole indication of cure, and was to be accomplished, by increasing secretion from the liver, and the mucous membrane of the stomach and bowels. Those who adopted this hypothesis, as simple as the gastro-enteritis of the French school (but suggesting, in the opinion of its advocates, a totally different practice), built their hopes on drastic purging, and, consistently, made calomel the governing article of their prescriptions. Thus the mercurial and cathartic treatment became united into one method, which in its application substituted, for the discriminating skill of the physician, the relentless punctuality of the apothecary and the nurse. Calomel, in doses which the world had not hitherto known, was given to excite the liver and mucous membrane into increased secretion, and drastics, in corresponding doses, to drain the bowels, as fast as those fluids were poured into them. The object was not to supersede the febrile action, by a mercurial irritation of the general system; but to rouse the liver and gastro-enteric membrane into secretory excitement; and thus transform the blood of the portal viscera into bile and liquor-intestinalis. To this end, scruple doses of calomel were regarded as sufficient for the mildest cases only; and drachm doses, at short intervals, became a familiar prescription, in ordinary epidemics; while, in those of greater violence, portions of half an ounce, an ounce, or an ounce and a half, were swallowed by the patient several times a day; till in some instances, a pound, or a pound and a half, was administered to a single patient, and gave to his excretions the appearance of chalk! I am not at liberty to doubt the testimony collected in the south, on which I make this statement. In the State of Mississippi, a physician assured me, that he had given a patient, one thousand grains for three successive days! As the purgative effects of calomel do not increase with the dose, and yet purging was an essential part of the cure, medicines better calculated to excite it, were either alternated or combined with the calomel; and these were very commonly given in vast doses. A respectable planter, in the same state, assured me, that he had given, by order of his physician, such quantities as I thought incredible; till I met with a neighboring physician, who declared that he had administered, in a single case, six hundred grains of a triple compound of aloes, rhubarb, and calomel, in equal quantities, for six consecutive days! Such instances, I am happy to think, embrace the extremest abuses of this method; and the number who reached these criminal limits, was perhaps not very great. It cannot be denied, however, that the practice, here reprobated, was for several years, that on which numerous physicians of the west and south rested their hopes; and although in general they stopped short of the recklessness of a few, they carried their single idea to an excess, which at length produced a revulsion in the public mind; and in numerous instances led to their being superseded by empyrics, who declaimed equally against the judicious, and the headlong administration of calomel. Under this reaction, it became, at least, difficult to exhibit that medicine in any dose, and the blue pill is now often substituted, when calomel would be preferable.

It does not appear, I think, that the immense doses of calomel, administered by a few fanatics, did any more injury, than the drachm doses of the majority of physicians. These doses often passed through the bowels undissolved, and inactive. They did not salivate or purge more than the smaller portions. They were, however, a revolting absurdity. The drastic purging to which the patients, day after day, were subjected, was no doubt as pernicious, though not so frightful to the people, as the mercurial ravages, which in many instances accompanied this practice. The former were invisible, the latter visible, to the public eye. That the purging practice was often contra-indicated by, or produced inflammation of, the mucous membrane, no sound pathologist can doubt; and therein consists one of the weightiest objections to the practice. Another is, that in cases which had any latent tendency to those paroxysms of collapse, which are called malignant or congestive, excessive purging soon developed it, so that it has grown into a saying in many parts of the south, that congestive fevers are made by this practice. Further north, the same purging, has often led to the production of a typhous state, equally, though not so immediately dangerous. Finally, both this and the practice of the Broussais school, are liable to the grave objection, that they aspired to be curative, when, in their most judicious application, they were but preparative.

Having given this brief narrative of the methods of treatment, which have prevailed, and indeed still prevail among us, I proceed to speak of that, to which public opinion has for some years been tending, and which seems to me yreferable to any, which has yet been followed.

V. Tendency at the Present Time. — Both the methods of treatment we have just discussed, are modifications of the first, and that which we are now to study, can claim nothing more. Its fundamental principles are, that autumnal fever is the product of a specific cause, and, therefore, consists in a morbid action of a peculiar kind, requiring a specific remedy; that we possess such an antidote for the intermittent variety of the Fever; and, that, we have only to abate all the causes and points of difference between the two varieties, to render the sulphate of quinine as efficacious in one as the other.

But what *are* the pathological differences between them? The answer must be, that we do not find them, in the functional disturbances and morbid secretions of the liver and *primæ viæ*, which are generally as great in the intermittent as the remittent type. They seem to me to consist in a higher febrile excitement of the whole system; a greater tendency to visceral hyperæmias and inflammations; a much longer hot stage; and the consequent want of a complete intermission. These conditions being obviated, the antidote will take effect, as in an ordinary intermittent. The old treatment, it is true, proposed all this; but the change in the condition of the system was to be accomplished gradually; and as each exascerbation of the Fever, added to the lesions of innervation, or renewed the inflammation of some organ, it often happened, that a suitable condition for the administration of the antidote was never reached.

The new modification of treatment, consists in transforming a remittent into an intermittent in a single day, and by a single agent. As stimulation will raise an intermittent into a remittent, so an opposite treatment may suddenly change the latter into the former; or, at least, so reduce the excitement of the heart and arteries, that the pathological state of the patient is an equivalent for the apyrexia of an intermittent.

Bloodletting is the means for accomplishing this end. To be successful, however, it must be employed in the first, second, or third paroxysm, that is, before inflammation in any organ has become established. The quantity taken, must be such as will bring the patient to the verge of syncope. Pallor and perspiration of the face, yawning, nausea, and a feeble, empty, and rapid pulse, must declare, that the excessive excitement of the system is, for the time being, effectually brought down. If these effects be not produced, the preparation of the system for the antiperiodic is not accomplished.

After such a bleeding, we may or may not administer an evacuant; but, if decided on, it should be given *without delay*. In the higher latitudes, ten grains of calomel, ten of jalap, and one of tartar emetic, mixed, or a solution of the last, with sulphate of magnesia, may be administered. To the south, two or four grains of ipecac may be combined with ten or fifteen of calomel, and, in a few hours, worked off with castor oil, and oil of turpentine, mixed, or an infusion of senna and manna. By the sudden and profuse evacuation thus effected, the condition of the system, produced by the bleeding, will be augmented, and the *primæ viæ* prepared for the reception of the antidote. But if the signs of gastric and biliary disorder should not be great — if the stomach has not been previously irritable, nor the bowels obstinately costive, nor the eyes and skin tinged with bile — the cathartic may be omitted.

Having thus lessened the volume of blood, reduced the power of the heart, and increased the susceptibility of the system; having, in other words, brought about a transient, artificial intermission, the sulphate of quinine, as the specific alterant, must be immediately and liberally administered. If it be deferred, another paroxysm will form; just as we see the fever in scarlatina or small pox return, after bleeding, even to *deliquium animi*. Those diseases, respectively, depending on specific causes, will not yield to a simple antiphlogistic treatment; in like manner, the Fever we are now studying depends on a specific cause, and demands for its cure something that can supersede the morbid action. To this end, ten grains of the sulphate of quinine, with one or two of opium; and, if no calomel have been given, ten grains of that medicine, should be exhibited in a single dose. The results which may be expected are sleep and perspiration, with a full, slow, and soft pulse. In the latter part of the following night, the dose of quinine must be repeated, with or without the other medicines, and again repeated about noon the next day. It does not follow that the patient will not, at that time, have some degree of thirst, pain in the head or back, and increase of pulse; but his warm perspiration will continue. In this exascerbation, an injection may be administered, if he had not been previously purged, or he may be bled again. At bed-time, a fourth dose of the quinine, with an equal quantity of Dover's powder, should be taken, and another portion of quinine should be exhibited early the next morning. If he had not been freely purged at the beginning, he may now take a stimulating cathartic; but, if possible, should use the pan, and not leave his bed during the operation. In the early part of the following night, he must repeat the quinine and Dover's powder, after which a repetition will scarcely be required. He ought, however, to keep in bed for two or three days longer; a gentle diaphoresis should be kept up, and the healthy action of the liver restored, by small doses of the blue pill and quinine, with a gentle opiate at night.

In principle, this method is the same which we find successful in pneumonia, hepatitis, and some other phlegmasiæ, except that the alterant used is different. In pneumonia we do many things, but the detraction of a great quantity of blood, followed by the immediate administration of large doses of tartar emetic, will effect a cure; in acute hepatitis a similar bleeding, succeeded by full doses of calomel, will bring out the desired result. The same is true of acute peritonitis, which, readily yielding to these measures, proves fatal without them, notwithstanding many other things may be done. In these phlogistic fevers, tartar emetic and calomel, respectively, exert an alterant influence, which, without the previous bleeding, they could not. *They* have power over *common* phlegmasial fever and inflammation; but not over the *specific* fever, and its associated inflammations, which constitute the disease we are now studying. To supersede *them*, we must establish in the system (rendered unresisting by the loss of blood), an action incompatible with the febrile and inflammatory—a transient quinic disease, which, ceasing spontaneously, leaves the patient free from his original disorder.

But this happy result is not always attainable, and we must now consider the causes of failure. I have limited the commencement of the proposed treatment to the third paroxysm; but there may be cases in which it will succeed, if begun in the fourth or fifth; nevertheless, the earlier, the better; for, if inflammation have become *established* in any organ, it may not yield to bloodletting, the quinine, or any other means. Moreover, the longer the fever has continued, the less is the quantity of blood which can be taken away with impunity. The vital energies have begun to fail; the susceptibilities have become more perverted, and the blood has fallen into a vitiated condition. Under these circumstances, if a free bleeding should be practiced, a dangerous constitutional irritation may follow; for copious venesection renders the heart and arterial system irritable; and thus gives to the deteriorated blood, a reactive influence upon them, which, before the operation, it could not exert. The practice of bleeding to relieve inflammation, in an advanced stage of the Fever, has been condemned, even by those who bleed freely in the beginning. But may not an immediate exhibition of quinine obviate the objection to such a bleeding? May not that medicine, even, contribute to the cure of the inflammation? Is not the inflammation as much a part of the Fever, as the pustule is of variola, a quinsy of scarlatina, or the abscess of a lymphatic ganglion, of the chronic fever, present in some cases of scrofula? These questions must be answered, I think, in the affirmative; and, if so, we might expect advantages from the quinine in remittent fever, even when inflammation exists. If, however, it should not possess a power of that kind, it would not, I suppose, increase the inflammation; while its peculiar sedative and semi-narcotic operation, would aid in repressing the constitutional irritation, which might follow bleeding in the stage of the Fever, we are now considering.

Although inflammation is not the cause, but arises with, or supervenes upon, remittent fever, still, it is not on that account the less dangerous. When it begins with the fever, it generally yields to a copious bleeding, and the subsequent use of quinine; but when its development is late, it often sets our utmost efforts at defiance. Among the means which may be employed for its abatement, there are three external applications, in which considerable confidence may be placed: *First.* Long continued tepid ablutions and fomentations over the affected organ. *Second.* Repeated topical bleeding. *Third.* Blistering, which, however useless when there is no inflammation, is of much value when that condition exists. There are, moreover, several medicines, which may be employed with advantage. Thus, if the inflammation be seated in the liver or spleen, calomel should be administered in doses of four or six grain doses every two or four hours, according to the violence of the symptoms; if seated in the mucous membrane of the stomach and duodenum, the same medicine, triturated with gum arabic, refined sugar, and opium, or the sulphate of morphine, should be employed; if the lungs be the seat of the inflammation, tartarized antimony, and other sedative expectorants may be used; if the brain, calomel with cathartics, will be proper.

Should any one of these inflammations become intense, the fever may assume a continued type; when quinine would, perhaps, prove useless; but, if remissions still manifest themselves, that medicine should be mingled or alternated, with the other means which have been recommended.

VI. Facts bearing favorably on the early exhibition of Quinine.—The treatment recommended under the last head, is one which I have pursued, as occasional opportunities offered, since the year 1838 or 1839. The effects have been highly encouraging, but I am not under the necessity of commending it on such limited grounds, for in several long journeys, from 1840 to 1844, I collected the experience of a multitude of physicians, from the Gulf of Mexico to Lake Superior, and will present an abstract of that portion which is in favor of the early administration of quinine.

At Milwaukie, N. L. 43°, remittent fever is almost unknown; but Doctor Hewet, had treated cases successfully on the old method of venesection (in some cases), emetics, cathartics, and diaphoretics, for a week, when he administered the sulphate of quinine.

The Fever is somewhat more prevalent at Racine, a little further south; the treatment, as I learned from Doctor Blanchard, and Doctor Graves, the same as that just mentioned.

Chicago, still further south, on the same western coast of Lake Michigan, is far more infested with the Fever. Its treatment, as stated by Doctor Brainard, Doctor Brinckerhoff, and Doctor Kimberly, is substantially the same as at the two other towns.

At Port Huron, N. L. 43°, the Fever is frequently epidemic. Doctor Noble informed me that he seldom bleeds; but after the operation of an emetic and mercurial cathartic, administers Dover's powder and camphor, till an intermission with perspiration is obtained, when he resorts to quinine.

At Detroit, Doctor Potter regards bloodletting as a most important remedy. Doctor Pitcher, a gentleman of ripe experience, resorts to the lancet early, gives a cathartic of calomel, and then administers quinine, in five or ten grain doses.

Doctor Denton, of Ann Arbor, west of Detroit, is a strong advocate for bloodletting; to which he resorts in the cold stage, rather than the hot, and sometimes bleeds twice in one paroxysm; but does not administer quinine, till after the lapse of six or seven days.

Doctor Landon, of Monroe, south of Detroit, has bled freely, and saw the blood sizy; then purged copiously, and proceeded to the administration of quinine; which he has often given with success, when the tongue was still heavily coated.

The estuary of the Maumee, at the south west angle of Lake Erie, is infested with this fever. Doctor St. Clair bleeds freely and has often seen the blood sizy; uses emetics, and cathartics; but does not begin to employ the quinine for several days afterward.

Doctor Peck bleeds, vomits with tartar emetic, and purges with calomel and other cathartics till an intermission is obtained. In this condition, when the tongue has become clean, and the patient seemed convalescent, the next paroxysm has set in with coma, and that which followed proved fatal. In other cases, this sinister effect has been averted by five grain doses of quinine, in conjunction with the same quantity of calomel.

Doctor Dwight has, in some autumns, bled freely, and seen the blood buffy, purged with calomel, and then administered quinine.

Doctor Van Every, in the autumn of 1838, bled in almost every case, sometimes to twenty ounces — after which, cathartic medicines operated freely, when he gave three grains of quinine every two hours.

Doctors Smith and Perkins, did not bleed very often, but found the early use of quinine, in two grain doses, every two hours, successful.

In the same fever, Doctor Ackly gave the blue mass, or calomel with morphine and ipecac, or tartar emetic every three or four hours, till a diaphoresis occurred; when he administered a cathartic, and then resorted to quinine. All these observations were made in the same region.

Doctor Cochran, of Sandusky City, south side of Lake Erie, has bled freely, given a few large doses of calomel, and then administered ten grains of quinine every eight hours, till perspiration came on.

Doctor Tilden, of the same city, has seen bleeding, vomiting, and purging, do harm, when not followed by an early administration of quinine.

At Norwalk, near Sandusky, Doctors Baker and Kitteridge, have bled, in some cases several times, and found the blood sizy; administered calomel freely, purged with extract scammony and colocynth, followed with castor oil, and as soon as the remissions were made a little more perfect, administered quinine.

Doctors Manter and Howard, of Elyria, on the same lake-terrace with Norwalk, have found quinine injurious in the Fever, before it was brought, by one or more bleedings, to an intermittent type. Have often seen the blood sizy.

Doctor Wallace, of Massillon, Ohio, bleeds freely, once or twice, and, without waiting for an intermission, proceeds to give quinine in five grain doses.

At Joliet, on the Illinois River, Doctor Scholfield informed me that he was in the habit of giving his patient from twenty to forty grains of calomel, with half a grain of sulphate of morphine, while in the exascerbation, and following it the next day with castor oil or salts, immediately after which, he administered the quinine.

Doctor Howland, of Ottawa, on the same river, bleeds, and if the patient have been costive, gives a cathartic of blue pill and rhubarb; otherwise he proceeds at once to administer quinine.

Doctor Whitehead, of Lasalle, on the same river, in an epidemic remittent, omitted bleeding, administered a dose of calomel and pulvis antimonialis, as a cathartic, and then gave quinine in two or three grain doses, sometimes combined with Dover's powder, every two or three hours. It arrested the hot stage, and brought on perspiration, with a slow and full pulse.

In Springfield, the capital of Illinois, I found Doctors Todd, Henry, Jayne, Merriman, and Frazier, concurring in the practice of very moderate preparatory evacuation, either from the bloodvessels, or the bowels, and an early administration of quinine and opium.

At Jefferson City, on the Missouri River, Doctors Abbott and Edwards, in the declining stage of the first paroxysm, without any previous preparation of the system, begin the administration of quinine in two or three grain doses, at short intervals, till the paroxysms cease to recur, when they give a mild cathartic. When the fever is strongly remittent, they bleed before using the quinine.

Doctor Price, of Arrow Rock, further up the Missouri River, is accustomed to resort to quinine after the operation of a single cathartic or emetico-cathartic, notwithstanding there may be head or back ache.

Doctor Vaughan, of Dover, near the same river, does not often use the lancet, nor administer evacuants, but begins the treatment with quinine and calomel.

Doctors Shanks and Frazier, of Memphis, Tennessee, are accustomed to employ the lancet, cold to the head, some small doses of calomel and ipecac, and then, at an early period, to complete the cure with quinine. Doctor Christian, of the same city, in latter years, bleeds once, gives a few doses of spirit of nitrous ether, and then the quinine; in six or eight hours, a gentle cathartic, and quinine again; which method cures in one third the time of that which he formerly pursued. Doctor Grant, of the same city, formerly of the hill country, in Alabama, while there, bled freely, cupped, blistered when the stomach was irritable, gave a full dose of calomel, and in the first remission afterward, gave twenty grains of quinine in a solution of tartaric acid. A slow and full pulse, with perspiration, followed.

Doctor Hicks, of Vicksburg, Mississippi, after one bleeding, and a dose of calomel, or blue pill, with ipecac, administers quinine with happy results.

Doctor Gist, and Doctor Cabannis, of Jackson, Mississippi, purge moderately, in most cases with castor oil, and, in the first remission, give quinine, which they think tends to promote intermissions. In some cases they bleed.

Doctor B. Yandell, of Benton, Mississippi, often employs the lancet, and begins the exhibition of quinine, before the end of the paroxysm.

Doctor Davis, of Natchez, bleeds, and resorts almost immediately to that medicine. It abates the thirst, and the force and frequency of the pulse, increases its fullness, and promotes perspiration. In the cases in which it fails to produce these effects, he throws it aside. Doctor Jones, of the same city, seldom bleeds, but after the operation of a dose of calomel, or blue mass, followed by castor oil, proceeds to administer the quinine, in five grain doses, every three or four hours.

Doctors Tate, Estes, and Winter, of Columbus, Mississippi, have found that many cases of remittent fever, treated only with aperients, and cold acidulated drinks, assume an intermittent type, and are cured with the quinine. These physicians, with their brethren, Doctors Smith, Jones, Lipscomb, and the Malones, have found the lancet unnecessary, or injurious, and drastic purgatives still more so. After gentle alvine evacuations, they depend on quinine.

Doctors Beall, McCune, and Wilkins, of Pickensville, Alabama, on the Tombeckbee River, below Columbus, condemn free purging, and do not employ the lancet, without following it immediately with quinine.

Doctor Drish, of Tuscaloosa, in the same state, frequently bleeds, sometimes vomits, purges with calomel, or the blue mass, combined with opium, and then gives one or two grains of quinine, with piperine or morphine, every hour or two. He has seen large doses of calomel produce watery discharges.

Doctor Billingslea, on the Tallapoosa River, has used large doses of quinine immediately after bloodletting.

Doctor Echols, of Selma, bleeds, but generally omits active purging, and proceeds to administer quinine.

Doctor English, of Cahawba, bleeds, cups, administers a mild cathartic, and then gives quinine.

Doctor Hogan, of the same region of country, as his partner, Doctor Stone, informed me, stimulates, and administers quinine from the beginning, with admirable success.

When at Natchez, in 1844, I was told by Doctor Cartwright, that Mr. Charles Crossgrove, a respectable superintendent of a cotton plantation, in Concordia Parish, Louisiana, had administered quinine with great success. I had a conversation with him on the subject, and, he, also, gave me a written statement, of which the following is the substance:

On the plantation there are fifty-five negroes, and a white family. No physician had been employed for three years. Autumnal fever, in its different varieties, had been the chief disease. He began the administratation of quinine without any previous evacuation. The first day, he gave two doses, of ten grains each; the next day, three doses, of the same size. He never had occasion to administer the medicine beyond the third day, and it had never failed, in a single case, to "break the fever." It is worthy of remark, that, on the plantations of the south, the treatment is begun with the beginning of the Fever, before deep-seated congestions or inflammations have been formed.

Finally, I may add, that, when exploring the statistics of the great Charity Hospital of New Orleans, in 1844, I found that a change had taken place in the method of treating patients there, as great as I have found over the country at large. The mercurial and drastic practice had given way to mild aperients, occasional bloodletting, and an *early* exhibition of quinine; the effect of which had been a diminution in the number of deaths, compared with the number of cases admitted into the hospital.

These citations show that, in all parts of the Interior Valley, there are physicians who, for several years past, have been changing their modes of practice in the *same* direction; and that, too, without borrowing from one another. The reform may be said to have arisen spontaneously in each portion of the country; and is, therefore, entitled to the greater confidence. The facts which I have presented were collected from 1840 to 1844, inclusive, and, at the end of the latter year, transcribed and arranged. During that period, and since, more has been published on the treatment of the Fever, than for a long time before; and almost every paper testifies to what I am attempting to establish. But I do not think it necessary to make a transcript of this published experience, as it is within the reach of our physicians, and does not materially extend our knowledge on this point, beyond the unpublished notes which have just been presented, however strongly it may confirm the conclusions to be drawn from them.*

It may be said, that I have given the evidence on one side only. This I grant, but I know of none on the other. All our physicians are advocates of the quinine-practice; and even those who postpone the administration of the antiperiodic to a later stage of the Fever, and subject their patients to a longer preparatory treatment, do not, in general, profess to have given the method, here recommended, a trial, and rejected it as injurious or ineffectual. They are only more conservative than their brethren — more attached to old ways — and yet, even the most cautious among them, have abated considerably in their diversified, and often, perturbating measures.

VII. REQUIRED MODIFICATIONS OF TREATMENT.—1. *From the Epidemic*

*The papers, to which I allude, may be chiefly found in the American Journal of the Medical Sciences, and in the Journals of New Orleans, St. Louis, Louisville, Cincinnati, and Buffalo. Several of them are from gentlemen whose names are in the foregoing catalogue of authorities. Of those with whom I had not the opportunity of conversing, I may mention Doctor McCormick, and Doctor Porter, U. S. A.; whose observations in Florida, confirm, in the amplest manner, all that has been said.

Constitution.—At different times our Valley has been visited by an epidemic constitution of the typhous kind. The effect of such an atmospheric influence, is to convert our remittent into a continued fever, or, at least, to give it a set in that direction. This complication of two diatheses, greatly increases the difficulty of the treatment; for neither the copious detraction of blood, nor the liberal exhibition of quinine, is apt to prove beneficial in such cases. They are, in fact, exceedingly difficult to manage, and demand from us the most careful consideration; but what may be said, can be best introduced under the head of typhous fevers; where the treatment of the so-called "typhoid stage" of remittent fever will also be presented.

2. *From a Northern Climate.*—In the northern part of the Valley, where autumnal remittents often incline to a continued form, quinine is, perhaps, not as efficient; and is, certainly, not administered in as large doses, as are given further south. Copious bleeding would, perhaps, increase the efficacy of that medicine in the higher latitudes, while it would, in turn, prevent any bad effects from the loss of blood.

3. *From a Southern Climate.*—The modification of the proposed treatment, which is required in the south, relates chiefly to the use of the lancet. The heat and moisture of the southern climates, in connection with the agent, whatever it may be, which occasions the Fever, so act upon the constitution, that acute inflammation, and a high phlogistic diathesis are not easily induced; and copious venesection, as a preparative for the quinine, is not so necessary, as in more northern latitudes. At the same time, that medicine seems to act more kindly, and to be borne in larger quantities, in those climates, than further north; of which more will be said in the next chapter.

CHAPTER VIII.

MALIGNANT REMITTENT FEVER.

SECTION I.

GENERAL REMARKS.

The malignant remittent, is the most dreaded form of our autumnal fever. Malignant intermittents, when left to take their course, will, it is true, terminate in death; yet they are curable; but, under every known method of treatment, malignant remittents often prove fatal. I speak of cases to which the alarming epithet is truly applicable; and not of all which, in the loose phraseology of the people, or even of the profession, are *called* malignant. In the middle latitudes they are rare; and, although more frequent in the south, especially below the thirty-third parallel, they are nowhere as common as malignant intermittents. In some seasons, and in certain districts of country, they are more prevalent than in others. In the year 1843, I traversed, on different lines, a zone, extending from Arkansas to Florida, which is more infested with this fever than any other portion of the south. It lies chiefly between the thirty-first and thirty-third degrees, and includes what are called the prairies and canebrakes. The soil of those districts, rests on cretaceous or "rotten" limestone. As every other form of autumnal fever prevails in the same zone, we are required to refer the whole to one remote cause; and confess our ignorance of the subordinate influences which generate the diversities which have been described.

I have conversed with many physicians, who had not recognized a remitting form of malignant autumnal fever. They spoke only of the intermitting. Others, however, had observed the distinction, and from them I collected facts, which, united with my own observations, give the following differential diagnosis.

SECTION II.

DIAGNOSIS AND PATHOLOGY.

I. There is no danger of confounding a case of malignant with one of simple or inflammatory remittent fever; for, in the former, certain symptoms which belong to the cold stage, continue in the hot, and even run through the remission.

1. The pulse does not rise in fullness and force during the exascerbation, as in the other forms of remitting fever, but remains undeveloped; being generally small, frequent, weak, and more or less variable. But when the remission begins, it generally improves in every quality; yet it does not become as healthy, as in the remission of a simple or inflammatory case.

2. The feeling of abdominal oppression, and the anxiety, restlessness, and gastric irritability, are deeper in this than in other forms of remittent fever; and these symptoms never cease entirely in the remission.

3. A coldness of the hands and feet, or of the ends of the toes and fingers only, continues through the hot stage, while the trunk of the body and the head are in high fever heat. With the arrival of the remission this coldness, in the milder cases, is replaced by a natural temperature; but, in the more malignant, it continues, though, in general, with some abatement. Doctor Pickett, of Mississippi, and many other experienced physicians, regard this, as the most characteristic sign of the form of fever we are now studying.

Malignant remittents may be distinguished from malignant intermittents; *First,* by presenting remissions only: *Second,* by showing less reduction of temperature: *Third,* by the comparative absence of cold sweats: *Fourth,* by more delirium, and less apopleetic drowsiness. With these exceptions, the description of malignant intermittents already given, answers very well for malignant remittents. In fact, the symptomatical diversity between them, is chiefly the difference between intermission and remission — between cessation and abatement. Yet, this difference is indicative of pathological modifications, which, from their obscurity and danger, demand a rigid investigation. In algid intermittents, the feeling of thoracic oppression, the dyspnœa, the thirst, and the icy coldness of the limbs, are either followed by death in a brief period of time, or they cease, and a comfortable intermission follows. In soporose intermittents, the apoplectic stupor ends in death, or the patient revives at the end of the paroxysm, and remains free, till the recurrence of the next. In both forms, there is such a complete suspension of morbid action — such a restoration of healthy function in the internal organs — that the patient seems almost free from disease, although the next paroxysm may prove fatal. He has neither fever, congestion, nor inflammation; but there is, in his system, a *disposition* to fall, again, into the pathological state of the preceding day; and the cure consists in changing or destroying this disposition, by the known antiperiodics.

Now, in malignant remittents, there is no time when the Fever is absent; and whatever irritations or congestions are formed in the cold stage—whatever inflammations are set up in the hot stage—remain, though moderated in degree, throughout the remission. Their continuance is, perhaps, at once the reason why intermissions do not take place; and the cause that this form of fever, is not as curable as the intermittent. Whenever, in simple remittents, a complete intermission is effected, the antiperiodic puts an end to the disease, as certainly as if it had been, originally, of that type; and we may presume, that if a perfect apyrexia could be brought about in malignant remittents, they would be as easily cured as malignant intermittents. The task lies in effecting this transformation — in procuring this absolute intermission.

II. To reach a full apprehension of the difficulties in the way of this enterprise, it is necessary to inquire into the pathological conditions, which have to be overcome.

1. In every case there is an original morbid state of the innervation, which may be designated by the terms, prostration and irritation; and which, moreover, is peculiar or specific, febrile and periodical. To this affection of the solids, much of the feeling of exhaustion, the anxiety, the restlessness, and the suspended or morbid state of the secretions, is attributable. The same condition exists in intermittents, and is doubtless the chief cause of death, when they prove fatal, without the supervention of apoplexy.

2. To the prostration and irritation of the solids, we must ascribe the congestions, which have given a name to the cases we are now considering. Our hydraulic, or mechanical pathologists, have too often overlooked this antecedent, pathological state, and found nothing to dread or avert, but these congestions. They have forgotten, that this unequal distribution of the blood, is the effect of an altered condition of the apparatus of circulation; that the greater the congestion, the stronger is the evidence of a deeply smitten state of the containing solids; and, consequently, the greater the danger. Still further to narrow down this theory, many of them regard the congestion as taking place chiefly in the great vessels, and in the cavities of the heart; to these alledged stagnant accumulations of the blood, they as-

cribed the danger. But while we grant that the vena portæ, the vena cavæ, and the right auricle and ventricle, are overcharged and embarrassed, we must extend our views beyond them.

In the fever now under consideration, the blood, which, before the attack was diffused through the whole body, becomes largely accumulated in the central parts. The subclavian and external iliac arteries, which, in health, receive a large quantity, and carry it far away from the heart, to be slowly returned, now receive very little; and an inordinate quantity takes the course of the carotids, the vertebrals, the intercostals, the bronchials, the coronaries, the cœliac, the mesenterics, and the emulgents, establishing a central or visceral plethora, in which all the cavities of the heart, the arteries, veins, and capillaries, participate; by which the whole are oppressed and many new symptoms, or aggravations of those previously existing, are produced. I do not suppose, however, that the blood continues to circulate equally, and freely, through all the organs; for it is soon discoverable that some are more oppressed than others; and, they are, of course, the special seats of irritation and congestion.

3. In this pathological condition, the secretions of the liver, stomach, and bowels, become highly morbid; and by their reaction upon the surfaces on which they are poured out, increase the very irritations, of which they are the products; thus augmenting the anguish, and the feeling of epigastric heat, which are such prominent symptoms in every stage of the Fever.

4. Out of the pathological conditions just described, arise inflammations. A morbid state of the vital properties of the viscera, in connection with congestion, it may be safely affirmed, cannot continue long, without originating inflammation; but, we are not compelled to rely on this apriori-view, for many cases of the Fever are attended with symptoms, which cannot be interpreted, except on the theory of inflammation; and unquestionable ravages of that local affection, have been found after death.

When inflammation is thus added to the previous debility, irritation, morbid secretion, and congestion, the complication is complete. Every element of difficulty and danger is present; and the concourse of symptoms displays, at once, a highly adynamic, and ataxic character. Should any one doubt the possibility of inflammation in one organ, while another remains in a state of passive congestion, and all are prostrated in their vital energies, let him contemplate for a moment, the phenomena which follow the escape of a portion of the contents of the bowels, into the sack of the peritoneum. Extreme prostration and irritation immediately ensue, and continue till the patient expires; before which event, however, the tenderness on pressure, the swelling, pain, and heat, clearly indicate a supervening peritonitis. The physician does not doubt its existence, notwithstanding the feeble and thready pulse, and resolves on venesection. When only four or five ounces of blood have been drawn, however, the patient faints, and no rise of the pulse, no reactive impulse of the heart, follow; yet, the blood is sizy, and a post mortem inspection discloses active hyperæmias and effusions of coagulating lymph in the peritoneum, with passive congestions elsewhere.

Thus it is demonstrated that inflammation may be set up, when the power of the heart, and the tone of the arterial system, are in a state of extreme reduction; and, also, that it may continue until death, without arousing them into energetic reaction; which, no doubt, happens in the form of fever we are now studying.

Indeed, great energy in the heart is not necessary to the production of inflammation, which, being an affection of the capillary extremities of an artery, arises independently of the heart; and may, therefore, be as readily established in one condition of that organ as another. But the legitimate effect of any inflammation, is to rouse the central organ of the circulation into greater activity and stronger impulse. In a common phlegmasia, for example, this is done. In ordinary autumnal fever, of the kind denominated inflammatory, we observe the same effect; but, in the malignant variety, such a consequence may or may not result from inflammation. Hence comes the variety which has been observed in the movements of the heart; some physicians having observed them to be essentially feeble, others strong, but tumultuous, and inefficient in the propulsion of the blood to distant parts of the body.

In proportion as the inflamed organ is incapable of exciting the heart into vigorous, phlogistic action, the case is malignant; and the diathesis, which prevents that reactive influence on the central organ of the circulation, constitutes the true distinction between malignant and inflammatory remittents.

Neither the simple congestion, nor the inflammation which occurs in this fever, seems to have any special or invariable seat. There is no fixed law of localization, like that which determines the inflammation in variola upon the skin, or in scarlatina upon the throat; yet, as we shall see hereafter, the abdominal organs suffer more than those of the other great cavities.

It is not likely that inflammation occurs in every case of malignant remittent; and if its ravages were found in all who die, they would only show that inflammation was probably the cause of death; while the patients in whom it did not occur, on that very account recovered.

Of the four pathological conditions — constitutional irritation, simple hyperæmia, morbid secretion, and inflammatory congestion, the first and last are most to be deprecated. When the first is so deep, that the excitement of the heart will not rise after bloodletting, or under the exciting influence of an inflamed organ, the prognosis is bad. On the other hand, whenever, from treatment, or the occurrence of inflammation, the heart rises in power, and the pulse becomes full and firm, the prognosis is better; for however intense the inflammation, it may be subdued or abated by treatment. Such a case presents the metamorphosis of a malignant into an inflammatory fever.

SECTION III.

TREATMENT.

I. Indications and Difficulties. — No physician enters on the treatment of a case of our malignant remittent fever, without a feeling of doubt as to the means, and of foreboding as to the result. To understand the sources of this misgiving, we must recapitulate the points set forth in the last section. *First.* There is a peculiar, original enfeeblement and irritation of the vital organs, the first effect of the remote cause. *Second.* This condition of the solids, occasions an internal accumulation of the blood, and passive congestions of some organ, or organs; which do not cease, but only suffer abatement in the remission. *Third.* In many cases, some of the congestions become inflammations. *Fourth.* Under the influence of one or more of these pathological states, the special functions of the organs, are either suspended, or increased, and at the same time perverted. In this morbid condition, the sulphate of quinine, as experience has shown, cannot exert the specific, alterant and antiperiodic effect, which follows its exhibition in the *apyrexia* of a malignant intermittent; and of course the first object should be, to bring the system into a state favorable to the action of that medicine. The accomplishment of this end has taxed the ingenuity of our brethren, in regions where malignant remittents prevail; but no methods of practice have as yet given satisfactory results.

II. Venesection and Cupping. — When the lancet has been employed, the most opposite effects have followed. In some instances the pulse has sunk still lower, and the feelings of oppression and anxiety have increased. The physician has looked anxiously for reaction, and a more vigorous pulse, but none have occurred. In these cases, the primary reduction of the vital forces, had been great, or the congestions were passive and uninflammatory. A pathognomonic symptom for this condition is certainly desirable; and it may, perhaps, be found in the feeble impulse of the heart, discoverable by applying the ear or stethoscope, to the precordial region.

But venesection, sometimes, does not produce syncope, but is followed by favorable reaction, or open excitement. In these cases, the pulse may be empty, feeble, and frequent, yet the heart generally manifests a firm though struggling impulse. When a more open and well-declared excitement follows the bleeding, the operation can generally be repeated with advantage, in the next exascerbation; and may even be required in the third, for the purpose of moderating reaction — the Fever having been transformed into an inflammatory type.

Cupping or leeching, may, of course, be advantageously employed, when venesection is inadmissible; and, as a further means of revulsion, the surface operated on, should be covered with emollient poultices. There are two regions which should be preferred for topical bleeding—the sub-diaphragmatic, and the spinal. A row of cups, should be applied, from one hypochondrium to the other, traversing the epigastric region, where a greater number should be placed, than to either side. By such cupping, the stomach, duodenum, liver, and spleen, the chief seats of abdominal irritation, congestion, or inflammation, are most effectively reached. Of the extent to which the spinal cord is involved in this fever, it is impossible to speak with certainty; but we can hardly doubt that it participates in the irritation and congestion (if not inflammation), with which we have to contend. A portion of the enfeebled and irregular action of the heart, depends, perhaps, on a morbid condition of this nervous axis; and a part of the defective circulation, limited development of caloric, and reduced sensibility of the extremities, may be plausibly referred to the same condition. Many of our physicians, under these, or similar views, have applied cups along the whole length of the spinal column; and the results of the practice have been such as to justify its recommendation.

III. External Stimulation. — Whether venesection or cupping be resorted to, it is beneficial before commencing, and throughout the operation, to immerse the hands and feet of the patient in hot water, rendered stimulating by mustard, capsicum, or common salt. In cases, moreover, in which we doubt the admissibility of bloodletting, it is safe and beneficial, before proceeding to the operation, to apply stimulants of a pungent kind, over the whole spine, the precordial region, or the epigastrium; surfaces on which we can certainly make a strong impression, when it might not be made on the extremities. Revulsion, from the internal organs, attends the cutaneous hyperæmia thus excited; the whole innervation feels the same influences, and the loss of a greater quantity of blood can be borne, than might otherwise be safe.

In fact, cutaneous stimulation and bloodletting combined, are among our most powerful means of exciting reaction. But we too often apply our stimulants to parts which are benumbed and nearly insensible; when their effects are limited to drawing into the cutaneous capillaries, a little of the stagnant blood, which still lingers in the muscles below. We see the redness, and suppose the organism, at large, must be acted on, when it is not. We deceive ourselves by supposing that derivation has been made from the affected organs, when it has only been made from the subjacent parts.

We make hot applications to the extremities, and when their temperature is raised, with *transmitted* heat, we illogically and illusively regard the effect, as identical with restored warmth from *developed* caloric — thus confounding a physical operation with a vital function — and are disappointed if the excitement of the heart and brain should not rise with the temperature of the heated limbs. If the same applications had been made to surfaces where the vital forces, the capillary circulation, and the calorific function were but little reduced, they would have acted with such energy as to carry an exciting influence into the central organs of innervation and circulation, when the loss of blood would have been better sustained.

But when no inflammation exists, the internal irritations and congestions are often relieved by these powerful revulsives; which, in fact, make a part of the treatment of all our physicians, however they may differ on other points of practice.

If I have not spoken of blisters, it was not because they are useless. For the purpose of exciting reaction, they are inferior to sinapisms; but, as means of revulsion, they are greatly to be prized. A large blister to the neck, when the brain is the seat of irritation or inflammation, is of much service; and, when the stomach and duodenum are specially affected, its influence is still greater; particularly if the surface be afterward covered, as I have already suggested, with a soothing, emollient poultice, which will promote a mild, suppurative inflammation of the skin, without pain or irritation.

And this leads me to say, that when our object in this fever, is not to excite the system, but to relieve the abdominal organs from inflammation or severe irritation, it is decidedly advantageous to allay morbid sensibility with gentle narcotics, while our sinapisms or blisters are in action. If the patient be kept in a state of suffering by the external application — if he be restless and irritable — the revulsion will never be as favorable and effective as if he be kept composed. And to the administration of an opiate there can be no objection, since inflammation is the only prohibiting condition, and its grade is too low and irritative, to make it such, in the cases we are now considering; or, if it should be otherwise, if the inflammatory action should chance to run high, the lancet would prepare the way for the anodyne.

IV. External Emollients. — I have more than once referred to the application of poultices to the irritated or inflamed skin. I come now to say, that when the brain is the seat of irritation or inflammation, the continued application of tepid water to the head, the hair having been shorn, is of much value; and, that for the relief of gastro-duodenal irritations or inflammations, it is, perhaps, still more valuable. A stream of tepid water cannot be made to fall for an hour on the epigastric and umbilical regions, without soothing the organs within. But, as inconveniences may attend that mode of application, the whole trunk of the body may be wrapped in a dripping-wet sheet, covered with any fabric that will confine the water, and thus keep the skin bathed in aqueous vapor of its own temperature. The revulsive and soothing effects of such an application are very great.

V. Vomiting. — As in malignant intermittents, so in the remittents we are now considering, antimonial emetics are inadmissible. Indeed, in the south, they are a generally admitted cause of the metamorphosis of simple into malignant remittents. They prostrate the general system still lower, generate gastric irritability, and excite serous diarrhœa. Yet vomiting is not always injurious. When the system is sunken and torpid, and passive congestions exist, a salt and mustard emetic often does good; but, in cases accompanied by, or tending to inflammation of the stomach or duodenum, with acrid secretions, the mustard is too stimulating, and the wine of ipecac, or a hot infusion of the *Eupatorium perfoliatum*, or of *Lobelia inflata*, should be chosen. Of the whole, the last is perhaps the best. While visiting the states of Alabama and Mississippi, in the year 1843, I learned, from many reliable persons, both in and out of the profession, that vomiting, with that medicine, had been found signally beneficial; and, in 1844, Doctor Monette, in a valuable paper on this form of fever,* bore unqualified testimony to its efficacy in the following language:

"Emetics of the ordinary kind, that is of ipecacuanha or tartrate of antimony, the latter especially, are unsafe in most cases of congestive fever; unless the action and sensibility of the stomach have been previously excited by pepper and brandy, or some other pungent aromatic. Without a previous use of these precautionary measures, the ipecac or tartar emetic may prostrate without vomiting, or it may possibly pass off by the bowels, and produce hypercatharsis instead of emesis as desired. Yet there is a valuable article of the emetic class which is, at the same time, stimulant and emetic. This is the *Lobelia inflata*, which excites immediate vomiting, without any attendant prostration.

"This article, when properly used, is one of the most valuable emetics and stimulants in the materia medica, for the treatment of congestive fever. Its action is prompt, speedy, and easy, in the evacuation of the stomach, and in developing excitement. Nothing is more gentle, nothing more safe, nothing more salutary.

"There are cases, wherein it is desirable, after the excitement and reaction have been partially restored, to discharge the morbid secretions and ingesta, from the stomach, when they have become a source of morbid irritation. In such cases, to insure the prompt action of the emetic, the patient should first take a wine-glass full of warm toddy, with the addition of a few grains of capsicum to rouse action and sensibility in the stomach. A few minutes having elapsed, a full dose of fifteen or twenty grains of ipecacuanha, mixed in a wine-glass full of warm toddy, may be taken with great advantage. The operation is prompt, and instead of prostrating the patient, it excites the general action of the system, and promotes a salutary excitement in the stomach itself, and the collatitious viscera. Soon after free emesis has taken place, the system and the stomach specially, should be calmed and equalized by a gentle anodyne of morphia, or camphorated tincture of opium. A teaspoonful, or less, of the strong tincture of the seeds of the *Lobelia inflata*, will often be preferable to the ipecacuanha, as acting more promptly, and inducing less tendency to prostration."

The advice to administer a narcotic, after the operation of a vomit, is highly judicious. Among other good effects which it may produce, is that of determining to the surface of the body; and, consequently, of making revulsion from the internal organs; to this end the vomit is an efficacious, predisposing remedy; for, as long as the stomach is oppressed or irritated by peccant matters, in any form of disease, perspiration cannot be excited. Moreover, vomiting at all times promotes that function.

VI. PURGING. — When congestion, either passive or inflammatory, occurs in the brain, cathartics are demanded; but the saline and hydrogogue are not proper. Pills composed of equal parts of calomel, rhubarb, and compound extract of colocynth, make one of the best; and the first dose should

*New Orleans Medical Journal, Vol. I, No. III.

be sufficient to effect a perfect evacuation. Should the cerebral disorder continue, the medicine may be repeated; unless a state of exhaustion should follow the first operation. The great object is to make revulsion from the brain; but this method may reduce the vital energies, faster than it diverts from the brain; and, still further, it may establish a mucous irritation in the stomach and bowels, which in the end may prove dangerous. Notwithstanding the great efficacy, then, of purgation in ordinary apoplectic congestion, and in cerebritis from common causes, there is a narrow limit to its utility in the cerebral affections, which sometimes accompany our malignant remittents.

When the topical affections, or localizations of the Fever are found in the abdominal organs, a much greater abstinence from active cathartics is required. If the patient have been costive, a freer evacuation is necessary; but even then, the operation should not continue after the existing contents of the bowels have been removed; nor should the subsequent administrations have anything for their object, but the evacuation, from time to time, of what may be poured into the bowels from their own mucous membrane, and the liver; the retention of which is always injurious. When diarrhœa is present, a moderate cathartic, followed by opium and stimulants, may be safe, and productive of a quieter condition of the bowels. In all cases, however, hyper-catharsis must be avoided as eminently pernicious.

Great care is necessary in the selection of cathartics. A portion of calomel — five, ten, or fifteen grains — worked off with a decoction of rhubarb, is proper; or the latter may be replaced with two drachms of castor oil, and one drachm of oil of turpentine, mixed; or with a powder of rhubarb and magnesia, should the previous discharges have evinced acidity. Another method of safe purging, in these cases, is, to give pills composed of two grains of blue mass, two of rhubarb, and one of ipecac: which may be quickened in their operation by any of the mixtures just mentioned, or by the compound tincture of senna. Whatever medicines may be chosen, they should not be permitted to operate, on the same day, more than two or three times; and even a single copious evacuation will be sufficient: the object (properly) in view, being the evacuation — not the production — of morbid secretions.

Such is the present state of medical practice, among the best observers, where malignant remittents most prevail; and it contrasts, strikingly, with the practice which it has superseded. Of the pernicious effects of incessant, and drastic purgation, I have already spoken, under the head of simple, and inflammatory remittents; which were, sometimes, transformed by it, into violent gastro-enterites; at other times, into still more dangerous malignant fevers. The pernicious effects of the practice were, however, incomparably greater in the form of fever we are now studying, than in the open inflammatory. Those who pursued the practice, saw in the cases before them nothing but an oppressive accumulation of blood in the abdominal organs — they had no end in view but its removal — they employed no means but those which would convert it into secreted fluids, and then evacuate them from the bowels. The certainty of increasing the debility of the patient was unheeded; and the danger of exciting or aggravating irritations and inflammations of the stomach and upper bowels, was overlooked. But, apart from these serious objections to the practice, was it fitted to accomplish the end they had in view? It certainly was not; for purging, produces an introversion of the blood, the very condition for which it was prescribed. In the treatment of erysipelas, scarlatina, and other acute inflammations of the skin, the beneficial influence of cathartic medicines is produced by their diverting from the surface. On the same principle, after extensive burns or scalds, a favorable suppuration is prevented by purging, which reduces the cutaneous circulation. Finally, the free operation of a cathartic, when an individual is in health, never fails to produce pallor, reduction of surface heat, and a shrunken aspect of the superficial parts of the body, showing a centripetal tendency of the blood; which, of course, accumulates in the vessels of the interior. A therapeutic agency which produces such effects, can never be adapted to the removal of the assumed abdominal congestions, in malignant remittent fever. The organs, it is true, may be depleted by the increased secretion; but the means employed, and the secretory actions which they excite, keep up the supplies of blood from the outer parts of the body, and thus maintain the congestion for the cure of which the drain was established.

VII. Calomel. — In the last chapter, an estimate was made, of the use of calomel in the treatment of simple and inflammatory remittent fever. If we found, that two high a value had been placed upon it, in the treatment of those varieties, and that its liberal administration had often done harm; we may expect to find, that, in the cases we are now studying, it has, still oftener, disappointed the expectations of those by whom it has been prescribed; for it is unquestionably true, that it acts more kindly and efficiently, in cases of an inflammatory character (after bloodletting) than in the adynamic and ataxic. The suspended, or morbid condition of the secretions of the liver, in connection with epigastric tenderness and anxiety, so often present in this fever, suggested that calomel could not fail to prove salutary beyond every other remedy, and for many years it was administered in large quantities, especially in the South; but, in 1843, and 1844, I found that this practice had been generally renounced; yet the memory of its failures and ravages, had not faded from the minds of the profession, or the people. It was exhibited for the fulfillment of various speculative conditions, as for exciting the liver into increased secretory action, that the portal circle might be relieved from congestion; for subduing gastro-duodenitis, extending into that organ, and for allaying simple irritation of the same parts.* The greater number had the first of these objects in view, and seemed to have lost sight of the fact, that the suspended, or morbid

* Some years before the visits of which I have spoken, a physician of Louisiana, flippantly and hyperbolically, wrote me, that in a certain epidemic, he had drawn "blood enough to float, and given calomel enough to freight, the steamboat General

action of the liver, was secondary, and the consequence of a localization of the Fever, in the form of irritation or inflammation, upon the hepatic system; or if they admitted the existence of those pathological states, they assumed, that calomel was the best means of curing them.

That moderate portions of that medicine, in connection with other remedies, are useful, cannot be denied; but their exclusive and inordinate use is greatly to be deprecated. After local bleeding, and the evacuation of the existing contents of the *primæ via*, by the means just pointed out, the administration of three or five grain doses of calomel, in combination with small quantities of opium, morphine; or Dover's powder, and a free use of slightly acidulated demulcent drinks, with abdominal fomentations, are safe and beneficial. But, the epigastric irritation may be allayed, and the biliary secretion reëstablished by other means. Thus, Doctor Monette* declares, that since he has *discontinued* the exhibition of calomel, his practice has been more successful than before. One of his formulæ for allaying gastro-duodenal irritation, is the following:

℞. Sulphate of magnesia, - - - ʒij.
Ipecac, - - - - - - - - grs. iii.
Tincture of opium, - - - - ʒi.
Water, - - - - - - - - ℥vi. Mix.

The dose is half an ounce every hour, or every two hours; according to the judgment of the physician in each case.

"This mixture, continued for twelve or fifteen hours, and sometimes, in less time, is followed by an abatement of the gastro-duodenal irritation, a general relaxation of the skin, and a full and soft pulse. Besides these salutary effects, a perseverance in the use of this mixture, for a longer time, is followed by a free and gentle discharge of *thick yellow bile*. During this administration, if the intestinal canal be in a high state of irritation from previous purgatives, or copious watery discharges, anodyne and emollient enemata are not to be neglected, nor demulcent drinks, of which none is superior to the mucilage made of the prickly pear by cold infusion."

Doctor Monette acknowledges himself indebted to Doctor McPheters, one of the most sagacious practitioners of Mississippi, for a knowledge of the efficacy of sulphate of magnesia, in small quantities, with laudanum, in the irritations we are now considering. The addition of ipecac, made by himself, gives, according to his experience, additional efficacy to the prescription. When there is much developed fever, he adds to the mixture an ounce of spirit of nitrous ether.

"The proportions of each ingredient may be varied to suit peculiarity of cases. If the irritation was extreme, the first recipe was used; and the quantity of sulphate of magnesia diminished one half, and the tincture of

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Jackson!" During my first visit, another who had given it by the ounce, said his object was, to *load down* the irritable stomach, so as to prevent vomiting! While multitudes believed, that when they did not obtain bilious discharges, by ounce doses, it was because they were too timid in the administration!

* New Orleans Journal, *loco citato*.

opium increased in the same proportion. If the duodenal irritation was moderate, and the bowels appeared irritated with a profuse secretion of acrid bile, the quantity of sulphate of magnesia was increased; and sometimes the tincture of opium was diminished in the same proportion."

VIII. Refrigerants, Sedatives, Chologogues, Diuretics, and Sudorifics. — I have joined these different heads together, because of their relations in practice. As long as the treatment of our malignant remittents was confided to unlimited doses of calomel, and unrelenting purgation, various means of a gentle character were entirely neglected, as inconvenient or incompatable; yet their adaptation to the form of fever now before us cannot, I think, be doubted; especially when the local congestions, irritations, and inflammations are seated in the abdominal organs. The continued introduction of pellets of ice into the stomach is often productive of relief; but they act merely as local coolers, by absorbing their caloric of fluidity from the parietes of the organ. Of all refrigerants, I suppose water to be the greatest; and am quite convinced, that its powers in this, as well as many other forms of fever, have not yet been fully tested. After the stomach and bowels have been evacuated, if the former should not be irritable, water should be drunk in large quantities; and, to give it greater efficacy, the system should be brought slightly under the influence of an opiate. As a topical application to the irritated or inflamed mucous membrane of the alimentary canal, it is one of the most soothing. But passing readily, by endosmosis, into the gastric veins, it is carried not only through the liver, but the entire organism; diluting the blood, and allaying the febrile irritation of the solids, abdominal, thoracic, and cranial. This is at once a cooler and a soother; and being one of the sustainers of life, refreshes and invigorates, while it allays morbid action. Other effects, however, result from its liberal introduction into the blood vessels. All experience proves that the system makes unceasing efforts to keep the amount of water in the blood uniform; and, hence, when the quantity is increased, the secretory apparatus is immediately excited into increased action, for the purpose of throwing off the superabundance. To what extent the secretion of the liver may be promoted by this agency we cannot decide; nor do we know in what degree the pulmonary exhalation may be augmented; but, from analogy, may presume, that both, and especially the latter, are increased. As to the other secretions there can be no doubt, for a flow of urine or of perspiration, according to the circumstances under which the individual is placed, invariably occurs. To obtain the former, the nitrate of potash or the spirit of nitrous ether, may be administered in appropriate quantities during the period of aqueous dilution. The first has long been regarded as a valuable refrigerant, and the last has maintained a high rank, as a febrifuge, under every modification of the theory of fever; while both direct the superfluous water upon the kidneys, and by increasing their secretion, eliminate from the blood, many things developed or thrown into it during the Fever, which, reactively, keep up the febrile irritation. But the action of the diluent upon the skin, is still greater than upon the kidneys, if the patient be placed under circumstances favorable to perspiration. These are rest, silence, and diminished light; adequate covering; heat to the extremities, and the administration of gentle narcotics and diaphoretics, such as a hot infusion of serpentaria, balm or orange leaves, with small portions of Dover's powder, or the following mixture:

℞. Spiritus Mindereri, - - - - - - - -	℥viss.	
Spirit of nitrous ether, - - - - - - -	ʒss.	
Camphorated tincture of opium, - - -	ʒss.	
Wine of ipecac, - - - - - - - - - -	ʒss.	Mix.

Half an ounce of this mixture, taken every two hours, will seldom fail to bring on perspiration, if the pathological condition of the patient be such as to admit of the restoration of that function of the skin. On the value of such an effect there can be but one opinion. The centrifical determination of the blood, without which the perspiration cannot be established, of course tends to relieve the internal organs from congestion; the reactive influence of an improved state of the skin, upon the liver and the mucous membrane of the stomach and bowels, must be admitted as a reality; finally, the blood is depurated of peccant matters, which often give to the perspired fluid an offensive odor; and, retained, irritate the interior of the arteries.

IX. Sulphate of Quinine. — The various means which have been pointed out, have for their object to convert the remittent into an intermittent: to produce a state of apyrexia, unaccompanied by visceral congestion, irritation, or inflammation. In many cases this is slowly accomplished, each remission becoming more perfect than the last; but in some the end is much sooner attained. When it is reached, the patient, as in the common inflammatory form of remitting fever, treated with active antiphlogistics, will sometimes recover if left to himself; but this should never be assumed; for, on the succeeding day, the paroxysm may return and prove as fatal, as the fit of a malignant intermittent. Had his fever been of a continued type, from some common cause, such an event could not occur; but being essentially periodical, the anti-periodic should, on no account, be now omitted. The quinine, which up to this time, when the remission has become more perfect, could not have been administered with advantage or even impunity, will now begin to establish in the system its peculiar effect; and the recurrence of the paroxysm will, at length, be precluded. It is not necessary to dwell on the mode of administering the quinine in such a case. Before an intermission is effected, it must be used in small quantities. But when that state is brought about, it may be given in five or ten grain portions, in connection with solid opium, and repeated every two or four hours. If great exhaustion should be present, it will be requisite to stimulate the patient with camphor, ammonia, or tincture of capsicum, wine-whey, wine, or ardent spirit; and, at an early period, to give him a moderate quantity of nourishing diet. His feet should be kept warm, and a gentle diaphoresis maintained. Should there be a tendency to diarrhœa, which the opium does not arrest, injections of starch, and a decoction of Peruvian bark, with laudanum, will be efficacious. If bile do not appear in the evacuations, small doses of blue pill may be conjoined with the quinine and opium, or the region of the liver may be sponged with a strong nitro-muriatic solution.

When one day has passed without a recurrence of the paroxysm, the patient will probably go on to recovery; but the quinine must not be discontinued, for the type may now change from quotidian to tertian; and, on the third day, the fever may return, unless the system be kept under the influence of the specific.

X. Cases and Remarks from Doctor Ames. — The following condensed account of seven fever cases, from Doctor Ames, of Montgomery, Alabama, shows that in negroes, at least, a manifest irritation of the brain does not contra-indicate the employment of the sulphate of quinine without previous evacuation. The symptoms and treatment were nearly the same in all, and all recovered.

"Tongue slightly coated, ash-colored, yellowish, or natural; sometimes dry, but never hard or fissured. Heat of the trunk and head natural, or a little below; legs and arms cool; feet, hands, nose, and ears, cold. Pulse, from one hundred and twenty to one hundred and forty, small, feeble, and indistinct. The brain strongly affected — coma and delirium alternating; the latter violent when the patient was disturbed; indisposition to speak; aversion to swallowing, with obstinate resistance. The stomach and bowels natural, except a little nausea in two or three. *Treatment* substantially the same in all. Blisters to the neck; mustard to the extremities; and sulphate of quinine in large doses, without regard to the stage of the disease. Convalesce in the whole begun before the fourth day."

Another case affords evidence coincident with this:

"A young gentleman, aged sixteen, was attacked with a chill, which was quickly succeeded by convulsions. His pulse was about eighty beats in a minute, nearly as full as in health, but soft and hollow; he soon became comatose, but was sometimes wakeful and restless; the temperature of his skin was everywhere natural; his pupils were dilated; he refused to swallow anything but water, and screamed and struggled violently when disturbed; did not speak, or even attempt to articulate. He continued in this state about forty-eight hours, during which he was bled to ten ounces, with a bad effect. He was repeatedly immersed in a warm bath, having cold applications to his head; he took a cathartic, which operated promptly; blisters were applied to his neck, arms, and thighs. Attempts were made to administer quinine; but, for sometime, very little was swallowed; atlength, however, he took it regularly and freely, with immediate benefit and complete recovery."

The following observations, from the same gentleman, present still further the results of his experience in the soporose, malignant fever, of the region around Montgomery:

"The coolness of the surface, in these cases, is never the coldness of collapse; nor is there ever the profuse sweating, the diarrhœa, vomiting, epigastric oppression, sighing, jactitation, and general restlessness, characteristic of abdominal, congestive remittents; neither have I, at anytime, observed muttering delirium, or picking of the bedclothes; headache is never, spontaneously, spoken of after the disease is fully developed, though it is a common precursory symptom. The aspect of most of the cases is that of profound sleep, but without the stertor or pulse of apoplexy. Now and then I have seen a case in which the skin was above the natural temperature, with throbbing of the carotids, but the pulse had no firmness. In that condition the coma is less profound. The refusal to swallow medicine is a characteristic of this form of fever."

"Quinine is better borne in congestive remittents and intermittents, than in any other form of fever. It is tolerated by the system, as tartar emetic is tolerated in pneumonia, and bloodletting in cerebral inflammation. I lately gave a negro boy, under twelve years of age, about fifty grains of quinine, within twelve hours, without producing deafness or ringing in the ears. Its good effects, however, were none the less evident. Bleeding, as far as I have seen, even in small quantities, does harm. Blisters and sinapisms are valuable adjuncts, particularly the former, and so is the hot foot bath. Nothing can be said in favor of purgatives; though I have occasionally seen full vomiting with tartar emetic, produce the best effects. When the pulse, under the use of quinine, gets more feeble as it becomes slower, with a copious supervening sweat, I know of no remedy equal to carbonate of ammonia, the quinine being at the same time suspended."

CHAPTER IX.

PROTRACTED, RELAPSING, AND VERNAL INTERMITTENTS.

SECTION I.

CHRONIC AND RELAPSING CASES.

I. We have already seen, that many facts conspire to prove that all the varieties of autumnal fever, depend on one specific, remote cause, and, we now come to an additional fact in support of the same conclusion. It is, that in many cases, the different forms of remittent fever, at last, assume an intermittent type; and continue to recur, for an indefinite period, in the manner of original, uncured intermittents; from which, in fact, they cannot be distinguished. This being the case, I have postponed an account of their character and treatment, until all the acute varieties of the Fever, of which they are properly the chronic form, should have been studied.

II. Regular, Chronic Recurrence. — When an intermittent becomes chronic, it generally shows a disposition to recur, at more distant intervals.

A quotidian, it is true, if neglected, may continue as such for several weeks; but such cases are not numerous, and a change to the tertian type is a common event. There are, moreover, many original tertians, which become chronic. In this form, when not arrested, they may run on for months. Sometimes a recurrence on the fourth day, including that of the preceding paroxysm, gives us a quartan; much more rarely, the return is on the fifth day, constituting a quintan. A recurrence on the seventh day (septan) is, however, common. This is the day on which the third paroxysm of a tertian, and the second of a quartan, would return; which, perhaps, explains the liability to recurrence on that day. But discarding all speculation, I may state, as a fact, that the hebdomadal period is, preëminently, that of many protracted intermittents; the recurrence of the paroxysm being, in some instances, between the thirteenth or fifteenth, in others the twentieth, twenty-first, or twenty-second, and in others the twenty-eighth, twenty-ninth, or thirtieth day. Still further, in some instances, after the Fever seems to have ceased entirely, it returns at a multiple of this hebdomadal period. The following case, from Doctor Raymond, illustrates this point: In the autumn, he had three paroxysms of intermittent fever. The next spring it returned, and was arrested by an emetic and half a drachm of quinine. In twenty-one days it recurred, and continued its visits, at the end of that period, until August. He was then bled, after which its recurrences were at the end of the fifth, instead of the third hebdomadal period, until December, when it was finally stopped by arsenic.

The causes which render intermittents protracted, deserve consideration:

1. Of the whole we should, undoubtedly, ascribe the greatest influence to the agent which produces the disease. It is of the very nature and essence of that agent, to generate an intermittent irritation; which shall soon pass away, but return at the end of twenty-four hours from the beginning of the previous fit, or at the end of some multiple of that period. We cannot, I apprehend, go further than to recognize the fact. In some constitutions, the primary impression wears out much sooner than in others: the latter present us with the disease in a chronic form. It is common to say, that the fits recur from habit; but habit is custom confirmed; and the question in these cases is, what maintains the custom until it grows into a habit? One person has a habit of waking at a certain hour in the morning; another at a different hour; in both cases some agent was employed to create the custom; but, after a time, that agency may be withheld, and the effect will continue from habit. Intermittent fever, then, cannot become chronic from habit; but having been made so by the influence of some cause, habit may, at last, contribute to reproduce the paroxysms.

2. The Fever is sometimes kept up by the unabating action of the remote cause. Thus, there are many instances of its continuance as long as the patient remains in the locality in which it was produced, and of its ceasing on his removal to a more salubrious spot.

3. It is probably rendered chronic, in certain cases, by the permanent congestion or subacute inflammation of some organ.

It is held by many of our people, and, perhaps, by some physicians, that if chronic intermittent fever be not interrupted by medicines, but allowed to run its course, until it ceases spontaneously, the individual, although continuing in the same locality, will, ever after, remain free from an attack. His system loses its susceptibility to the poison. A gentleman, in Illinois, assured me that this had been the result in his own case; and that he was led to make the experiment, by the assurance of others, that they had, by that method, obtained a permanent immunity. The greatest objection to such a course is, that some organ may become seriously deranged in structure.

II. RELAPSES. — Relapsing intermittent fever, is but a variety of chronic. The paroxysms cease from the influence of treatment; but the *tendency* to recurrence remains, and constitutes a true predisposition. An exciting cause is generally necessary to the reproduction of the paroxysm. An individual in this condition, is compelled to be circumspect, in regard to what the old pathologists called the non-naturals. The loss of a night's sleep, a day of protracted fatigue, exposure to cold and moisture, an excessive and indigestible meal, or a strong mental emotion of the depressing kind, may bring back the disease. In this predisposition, moreover, a cold, saline cathartic, often proves an exciting cause, and should be carefully avoided. But of all these causes, the exposure which chills the surface of the body, is most injurious. Hence it is, that those who have had the Fever in August or September, and may have been free from it in October, and the mild and dry portions of November, are liable to relapses afterward. These may occur uncomplicated with any other affection; but it frequently happens, that the sudden change of weather, which excites an inflammation of the lungs or some other organ, reproduces the Fever, so far, at least, as to give a paroxysmal character to the plegmasia, and render great modification of its treatment necessary. In addition to the external exciting causes which have been enumerated, we ought, perhaps, to recognize an internal pathological influence, in the enlarged spleen, which so generally occurs in protracted cases. That local affection, it is true, results from the Fever; but it often begins in the first paroxysms; and the experience of the profession is, I think, that, as long as it continues, the patient is more subject to relapses than others, in whom that organ is not disordered. Thus it seems to maintain the predisposition; and without being one of the exciting causes, renders the system still more susceptible to them, than it would otherwise be.

SECTION II.

VERNAL INTERMITTENTS.

I. The intermittents which occur in winter, are generally sporadic, and this may also be the case in spring. Nevertheless, the Fever often displays an epidemic character in the latter season. Whatever may be the number of cases in any locality, we are not to conclude, that they are the offspring of a poison developed in that season, but relapses, like those of winter. They are, generally, numerous in proportion to the prevalence of the Fever in the preceding autumn; the subjects are, chiefly, those who had suffered at that time; and the symptoms, and most successful treatment, mark them as relapses, instead of attacks from a new application of the remote cause. It would appear, that the steady cold of winter, is much less injurious, than the diurnal and occasional vicissitudes of February and March, in the South — of March and April, in the middle latitudes — and of April and May in the northern. After the hot weather has set in, they commonly cease; and this is the termination of the epidemic of the preceding year; which, beginning in the last month of summer, ends in the last month of spring. The Fever of the next autumn, depends on a new development and application of the remote cause; to the action of which, however, those who suffered the year before, are, very commonly, as liable, as those who might not have resided in the locality at that time, and, in many instances, more so.

The exciting causes of winter relapses, are equally productive of the vernal; and one of them — undue and chilling exposure of the surface of the body — is far more general; from the imprudent and premature disuse of flannel, and of winter clothing, upon the access of warm weather. Those who are obnoxious to the Fever, should therefore wear their flannel, till the hot weather is established, or even throughout the summer; and should carefully avoid exposure to the stormy weather of the equinox, or the sudden showers of April, both of which are more injurious than the snows and northwest winds of winter.

It is a popular opinion, that standing or sitting in the sun, in spring, will bring on a relapse; but this, I apprehend, is an example of false observation— the transposition of cause and effect. Those who *are* relapsing, find such exposure pleasant; a full development of the disease follows, and is fallaciously ascribed to the influence of the sun's rays.

The relapses which occur late in spring, are apt to present more of gastric and biliary derangement, than those which happen early. This results from the impress of heat, and the same cause, gives to the hot stage of the paroxysm. more intensity than it displays at any earlier period. These facts have led to the opinion, that the special, remote cause is generated *de novo*, at that time; but I see no reason for the supposition.

As a general fact, vernal intermittents are not violent nor dangerous, but there are exceptions; and the following observation, communicated to me by Doctor France, is one of the evidences. In Powell's Valley Virginia, intermittent fever was epidemic in the autumn of 1843. January was cold, but early in February, the weather became so warm as to give an impulse to vegetation; during which the Fever reappeared in a great number of persons, and, in many, assumed a malignant character.

II. Deferred Attacks. — The intermittents of winter and spring, as we have seen, are chiefly relapses, but there are, also, new cases. These are not to be ascribed to a reproduction of the special, remote cause, in those seasons, but to its impress in autumn; which impress was not followed by the Fever, at that time. On *page* 370, a case is related, in which the Fever appeared within three days after an exposure to its remote cause: The case now under consideration proves, that many months may elapse, before its development. For the existence of such cases, I may refer to the experience of every observing physician, who resides in regions infested with autumnal fever. Indeed, the profession are familiar with vernal intermittents, in those who had not suffered in autumn; all of whom, however, had been exposed to the remote cause. Many years since, the following fact fell under my own observation. A Cincinnati family made an overland journey, in autumn, to the State of New York, traveling slowly on the terraces of Lake Erie and Lake Ontario, which at that time were annually scourged with intermittent fever. Some of them were seized with the disease on the way, and others escaped. During the next spring, when the Fever was not prevailing in the part of the city where they resided, some members of the family, who had suffered in autumn, were seized with it; and at the same time, one of the party, who had escaped, was attacked with the same disease. Another, and, more conclusive observation, was communicated to me by Doctor Smith, of Racine, Wisconsin. When he resided in Vermont, two men made an autumnal visit to western New York, where the Fever was prevailing; and returned without experiencing attacks. In the following winter, however, one of them was seized, and, in the spring, the other, with the same disease. No other persons were attacked; and, indeed, no case of the kind had before occurred, in the part of the state in which they resided. At Quebec, where the Fever does not originate, Doctor J. Douglas informed me, that he had repeatedly known persons attacked with it, several months after their return from more southern regions, where it was prevailing; although they continued in health while there. These cases are analogous to those of Irish immigrants, who are, sometimes, taken with typhous fever, several months after their arrival in the West.

It is, perhaps, not correct to apply the term incubation, to the period which elapses in such cases, between the application of the poison, and the outbreak of the Fever. In the case of small pox and of hydrophobia, there is a progressive, or ingravescent change, perhaps in the innervation, which ends in the production of specific, morbid phenomena, that do not require an exciting cause to bring them out. But in deferred intermittents, the morbid impression constitutes a mere predisposition, which slowly wears away; and cannot, without the aid of exciting causes, originate the Fever. On the evidence which these cases afford, of a specific, efficient, remote cause, I have already spoken.

SECTION III.

TREATMENT — HYGIENIC AND MEDICAL.

I. Treatment of Winter Cases. — 1. I have introduced the word hygienic, into the title of this section, for the purpose of strongly directing the attention of the reader, to the more important part of the treatment. It may be truthfully affirmed, that after intermittent fever has been arrested, it would not often —perhaps never—recur, if all exciting causes could be avoided. Of course that is not practicable; but every predisposed person should withdraw from them, as perfectly as possible. Thus, the hygienic regulations deserve great attention. Warm clothing, with flannel next the skin, and shoes that will keep the feet dry, are necessary; but the patient should not house himself; for that would prolong his liability. On the contrary, with the surface of his body adequately protected, he should boldly encounter the cold of winter, and take a great deal of active exercise. The muscular effort will increase the depuration of his blood, by promoting pulmonary and cutaneous transpiration, while it invigorates all his solids. It will, moreover, give impulse to the portal circulation, and assist in rousing the sluggish abdominal organs into healthier action. The loss of sleep should be guarded against. To lodge warm is essential; but on rising in the morning, the surface of his body should be dashed with cold water; and then wiped dry, the friction being continued until it reddens the skin. Finally, his diet should be savory, nutritious, and digestible.

2. The medical treatment of these cases, has been in part anticipated, when speaking of the cure of simple intermittents. It resolves itself into that which is proper to prevent the return of the disease, and that required when it has recurred; and, *first*, of the former.

Some persons, are in the habit of taking small doses of quinine for this purpose; but they often fail. They do not establish a quinic diathesis, which, for the time being, would always arrest the paroxysms; nor do they give tone to the system. As a prophylactic, in these cases, the bark is much to be preferred, on account of its tonic, not less than its antiperiodic properties. A teaspoonful before each meal, will, in general, answer the purpose. The impoverished state of the blood, moreover, suggests the use of chalybeates; of which, perhaps, no preparation is better, than the protocarbonate of iron. It may be given in an electuary with the bark; for I am not aware, that the latter will lose any of its efficacy by yielding up a part of its tanno-gallic acid to the iron; or that the salt thus formed, will not produce all the effects of any other chalybeate preparation. Recently, a new preparation, the ferro-cyanate of quinine, has been introduced in practice, and, *prima facie*, seems likely to be useful; but I have not tried it, nor informed myself of the experience of others. Arsenious acid and opium, sometimes root out the predisposition to recurrences; but to do so, their administration should be continued, until the arsenical œdema is produced. The preservation of a regular habit of body is important; but in obviating costiveness, the cold and debilitating laxatives should be avoided. When required, powdered rhubarb may be added to the bark; or the tincture of rhubarb and gentian may be chosen; or pills composed of blue mass, rhubarb, galbanum, and aloes, made into a mass with extract of gentian, may be given. Whatever medicine is chosen, it should not be allowed to operate more than once or twice.

But all these things fail in some instances, and a treatment of the opposite kind succeeds. In such cases there is, probably, a subacute inflammation of some organ, as the spleen or alimentary membrane. From Doctor Frye, of Illinois, I have learned, that he has frequently succeeded in these refractory cases, by laying aside tonics and stimulants, and administering an eighth of a grain of tartarized antimony, with ten grains of hydro-chlorate of ammonia (sal ammoniac), given every two or four hours.

We come, in the *second* place, to the treatment required in the paroxysm. If the existing symptoms should indicate functional, biliary derangement, a mercurial cathartic will be proper; and if the stomach should be dyspeptic, an active emetic will do much good; but, in many cases, all evacuation may be dispensed with, and immediate recourse had to quinine and opium; which will, almost infallibly, arrest the disease so promptly, that not even another paroxysm will occur. The proportion of opium should be large; for, in the condition of the system we are now considering, there is great toleration of that medicine.

We must not forget, that along with these relapses, may come an inflammation of some organ, that will render these measures abortive or even injurious. Thus, the very cause which reproduced the paroxysm, may revive or generate a hepatitis, a splenitis, or a pneumonitis, in which case a certain amount of the treatment, required for the inflammation, will be necessary. In proportion as the inflammation is severe, the signs of its existence will be more or less present during the intermission. I have had many patients of this class, whom it was necessary to bleed copiously; but, further south, or in places where intermittents greatly prevail, copious bloodletting is inadmissible, and calomel, tartar emetic, cupping and blistering, must be employed. Everywhere, however, it is necessary to connect the opium and quinine practice with the depletory.

II. TREATMENT OF VERNAL INTERMITTENTS. — The hygienic means of preventing vernal intermittents, are the same as for those of winter. In spring, as we have already seen, one exciting cause is the great diurnal change of temperature. The elevated heat, after the system has had its susceptibility to caloric increased by the cold of winter, renders many persons impatient of warm clothing, and prompts the imprudent, to throw it off too soon. In doing this, however, they begin wrong. Instead of laying aside their winter coats, they take off their flannel; thus depriving the skin of a stimulus to which it had become habituated: whereupon it readily falls into torpor. Those who are strongly predisposed to attacks, generate but little animal heat; and, as we have already seen, instinctively expose themselves to the hot sun; which greatly increases the influence of low temperature, in the following night and morning. In addition to all this, damp south-west and north-east winds, about the time of the vernal equinox, act with sinister effect on the inadequately protected surface.

The required treatment of vernal intermittents, is somewhat intermediate, between that of autumnal and that of winter cases. In spring, the returning solar heat quickens the liver into action, and bilious appearances are then more common than in cold weather: the appetite oftener fails, and nausea, with other signs of gastric derangement, occurs in a greater number of cases. Hence, active evacuation of the stomach and bowels, is useful in many cases, and in some, almost indispensable. With this preparation of the system, or without any, in cases of a simpler kind, the antiperiodics may be administered, as in winter intermittents; and generally with the same immediate advantage. Now and then, however, a case will prove refractory, and continue until arrested by the heat of the summer solstice.

III. Change of Locality.—Some persons are so susceptible to the impress of the remote cause of intermittent fever, or the habit of recurrence is so readily and firmly established in their systems; that as long as they continue in an infested locality, the disease will set all the efforts of art at defiance. Change of place must, then, be submitted to, or the constitution will be ruined. In this, two objects should always be had in view: *First.* To seek a locality where the Fever is not endemic. *Second.* To reach a cooler climate, by change of latitude, or change of elevation. The former end may be accomplished by entering the depths of a city; by sojourning on the sands of the Pine woods; by wandering in the desert west of the Mississippi, or, emigrating to Santa Fe; all, without reference to a cooler climate. The latter end, is attained by ascending the Appalachian Mountains, where the Fever is nearly unknown, and the air invigorating. Of the regions fitted for this purpose, one of the most eligible, is that around Chautauque Lake, described at *page* 397. But all the benefits of mountain air may be enjoyed, without ascending above the mean level of the Valley, —six hundred feet—by going northerly. To this end, a voyage up the Mississippi, and a summer residence in the neighborhood of the Falls of St. Anthony; or a voyage to Mackinac and Lake Superior; or down the St. Lawrence to Quebec, and the deep chasms of the Saguenay, in the latitude of forty-eight degrees, may be performed with great facility. As soon as the patient reaches a region in which the Fever is not endemic, he feels that his redemption has begun; and, in a few weeks, finds himself quite restored. In the autumn of the next year, however, he may experience a new attack, when he should, if practicable, change his residence for a city or a colder climate.

When the constitution of a citizen of the south, has, by fever, or climatic influences, become seriously enervated, it is sometimes necessary to seek a colder climate, in winter, for the purpose of invigorating his constitution; that of the south being too mild for that purpose. By going north, in summer, he may, it is true, escape the Fever; but the heat of that season is there, for a while, high, and he may return without all the reinvigoration that is desired. Under such circumstances the influence of cold is necessary. With this conviction, Doctor Cartwright, of Natchez, not long since, spent the greater part of a winter, in the latitude of St. Louis, Louisville, and Cincinnati; fearlessly exposing himself, as he informed me, to the most rigorous winds; and returned home with a renovated constitution.

IV. Popular Empiricism.—Where agues prevail, many cases, not subjected to enlightened medical treatment, become chronic, and are at last broken up by some sudden impression on the nervous system. I refer to these experiments, not to legitimate them in our catalogue of remedies, but as throwing light on the pathological condition of the system; — as evincing that the disease, when thus prolonged, becomes a neurosis.

A case of the kind we are considering, is sometimes, permanently arrested, by a violent emetic, taken just before the chill. It imparts a shock to the nervous system, which destroys the disposition to recurrence. A countryman informed me, that, he stopped a tertian ague of eleven months duration, by taking, just before the fit, a quantity of gunpowder, mixed with rum. It produced on his system a powerful impression; and excited a profuse sweat, which continued for twenty-four hours, after which, the disease did not return. A very copious perspiration, produced by other means, has sometimes succeeded. The same beneficial result has, in other cases, been attained, by rapid riding on a hard-trotting horse, just before the paroxysm. The sudden affusion of very cold water has produced the same result. Doctor Joshua Martin, of Xenia, Ohio, knew the disease permanently cured, in a small boy, by 'standing' him on his head, at the access of the fit. Here was both a corporeal and mental effect. In many instances the recurrence has been arrested, by means which acted entirely on the imagination and feelings. Of this kind are various loathsome potions, which the patients have swallowed with disgust; and different charms or incantations, which raise powerful emotions, that change the innervation, and destroy the habit of recurrence.

V. Salutary Effects of Chronic Intermittents. — It has often been said, that protracted agues sometimes cure chronic diseases, and improve the health. That one disease may supersede another, from incompatibility of action, is certain; but I have not met with facts, which establish the remedial influence of intermittent fever. On the contrary, impairment of the constitution, has been the general result of protracted cases.

The alleged benefit to the consumptive, of a sojourn in localities productive of ague and fever, will be discussed hereafter; and I will only remark, in this place, that I once saw a palludal intermittent, unite itself with hectic fever; but not to the end of effecting a cure.

CHAPTER X.

PATHOLOGICAL ANATOMY, AND CONSEQUENCES OF AUTUMNAL FEVER.

SECTION I.

MORTALITY OF AUTUMNAL FEVER.

A simple intermittent fever, even when left to take its course, rarely, perhaps never, proves directly fatal; but it may derange the structure of some organ, or generate a kind of cachexia or spanæmia,* from which, as pathological causes, other, and at last fatal consequences may follow.

Many simple remittents, in the new settlements, are allowed to run their course without the superintendence of a physician; though seldom without some kind of medical treatment. In the early settlement of Kentucky, and Ohio, this was oftener the case, than in any of the new settlements of the present day; for considerable districts of country were, then, without physicians. In the former state, more than fifty years ago, I saw numerous cases, for which but little was done. In reference to these, as they occur in the middle latitudes, it may, I think be said, that they are not often mortal; but sometimes run a course of ten or fifteen days, and gradually cease, or degenerate into agues.

Inflammatory intermittents, demand the interposition of art, to bring them to a favorable termination. Left to themselves, it is true, they will not in general destroy life, immediately; but the persisting inflammation of some vital organ, may at last give a fatal termination. Under a well known treatment, however, such cases may generally, be cured.

It is otherwise, with inflammatory remittents, which, in their advanced stages, often take on a typhous character, and prove fatal. Of the proportion who die, it is impossible to speak. I have proposed to our brethren, in various places, to send me returns of the annual, relative mortality from the different diseases, occurring in their practice; but the amount of material thus obtained, is, as yet, too small to justify its presentation. I do not believe, that simple and inflammatory remittents, are more fatal in the south, than in the higher latitudes; but the mortality from them is greater, because they occur more frequently.

Malignant intermittent fever, is always mortal when not arrested by art; and many die from it every autumn, its true character not being perceived in time, or the patient residing beyond the range of enlightened medical practice. Where this variety prevails, therefore, it constitutes, in autumn,

* From *Aima*, blood, and *spanos*, poor — poverty of the blood: Simon's Animal Chemistry.

the chief outlet of human life; notwithstanding a successful mode of treatment has been discovered.

Malignant remittents are not so common as intermittents, but more difficult of cure, and, therefore, much oftener fatal.

In traversing the Interior Valley, from north to south, we find, that the number of deaths from autumnal fever, as compared with the number from all other diseases, constantly increases. In the higher latitudes, the prevalence of this fever is less, the variety of diseases greater, and the deaths distributed more equally through the year. In the south, the chief mortality is from July to November; though, in certain winters, large numbers die of pneumonia, engrafted on constitutions, enfeebled and deranged, by the insalubrious air of the previous autumn. Still, it may be affirmed, that below the thirty-third parallel, the inhabitants enjoy more uninterrupted health, for eight months of the year, than in any other part of the Valley; and hence it was not without reason, that the distinguished Professor Caldwell, several years since, attempted to show, that taking the year round, New Orleans was the healthiest city on the continent.

SECTION II.

CONDITION OF THE BLOOD IN AUTUMNAL FEVER.

Observation has established the fact, that the blood, in our autumnal fevers, may, or may not, show the buffy coat. In my own practice, it has been much oftener absent than present, and I have seldom seen it cupped. In most cases, the amount of fibrinous crust is not great; and, in the majority, it shows itself only in islets, or patches, which are sometimes indistinct. With these observations, I have found those of a great number of the physicians in the middle and higher latitudes of the Valley entirely correspondent. It is obvious, then, that a state of hyperinosis,* is not essential to these fevers; and that when it does exist, and, is made manifest by sizy blood, it is at once the effect and sign of an accidental inflammation. In general, the clot is large and soft, resting on the bottom of the bowl, and not swimming in serum, because the contraction has not been close enough, to press out that fluid, in large quantities. This may, in some cases, arise from the plethora of the patient before his attack, in which condition the red corpuscles are increased in quantity; in others, there may be a state of hypinosis,† or deficiency of fibrin.‡ In reference to the former, I may say, that men of a sanguineo-lymphatic temperament, the usual subjects of plethora, are oftenest the subjects of autumnal fever. The serum in this disease, is sometimes yellow from the coloring matter of the bile; but I have not found it bitter.

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*From *hyper*, excess, and *is-inos*, the fiber of the flesh. †From *hypo*, deficiency, and *is-inos:* Simon.

‡ Essay on the Blood in Disease: Andral.

I do not know, that any experiments have been made on the relative proportion of the proximate elements of the blood, in *our* autumnal fever. Andral and Gavarret, in the hospitals of Paris, made such experiments on the blood of seven patients, laboring under intermittents of long standing; and found the mean proportion of fibrin to be three and a third of one thousand parts, the normal quantity being three. As many chronic cases of the Fever, are made such by inflammation of some organ, we may presume, that in these cases some were complicated with such inflammations. As to the other proximate elements of the blood, the solid residue of the serum, was eighty parts in the thousand, the natural proportion; but the blood-corpuscles were, on an average, one hundred and four parts in a thousand, while one hundred and twenty-seven, is the normal number. Thus, it appears, that protracted intermittents, produce impoverishment of the blood — spanæmia — the condition present in chlorosis; and this accounts, in part, for the peculiar hue and puffy visage, of old ague patients, who so closely simulate chlorotics, in their appearance.

SECTION III.

PATHOLOGICAL ANATOMY OF INTERMITTENT FEVER.

It has been already said, that our simple intermittents do not prove fatal; how then can we know, by anatomy, whether any single organ always suffers? If any one be invariably affected, it is, undoubtedly, the spleen, if we may depend on what is presented by patients laboring under chronic and relapsing agues. Our inflammatory intermittents, moreover, but seldom prove mortal; but they often show signs of splenitis; and when the subjects of them die, subsequently, of other diseases, it is common to find vestiges of serous splenitis, in old and firm patches and bands, of coagulated lymph; which sometimes distort the organ, and at other times compress it, and, by limiting its circulation, produce a state of atrophy. During the ten winters in which I delivered clinical instruction in the Louisville Commercial Hospital, my colleague, Doctor, now Professor Bayless, and myself, met with many examples of what is here described; the patients having died of other maladies than intermittent fever.

The anatomy of our malignant intermittents ought to be well known, but it is not; for in the country, the prejudices of the people against post mortem inspections, especially after death from common diseases, is almost unconquerable; and in our cities the disease scarcely ever occurs. It must be confessed, moreover, that from want of practice in dissections, many of our brethren, living in new and remote settlements, infested with this fever, are not as well prepared to report on morbid appearances, as some of those who have greater opportunities of cultivating pathological anatomy, in places where the Fever seldom occurs. In traveling, I was only able to collect the subjoined observations.

1. Assistant Surgeon Holmes, gave me the following case. A soldier, in Florida, of intemperate habits, but vigorous constitution, died in sixteen hours, that is, in the first fit of a malignant intermittent. The chief signs of congestion during life, were in the chest, the parietes of which, displayed an ecchymosed appearance. Blood could not be obtained by venesection. Eight grains of tartar emetic operated as a cathartic; after which he took large doses of the sulphate of quinine. On examination after death, the mucous membrane of the stomach was found healthy; that of the bowels had more or less congestion; the liver showed signs of the same condition; and the spleen was double its natural size; but healthy in texture and appearance. The cavities and substance of the heart were engorged, and the lungs were loaded with blood. The brain was not examined. This individual had probably experienced a previous attack of intermittent fever, which produced the enlargement of the spleen, and hence its natural appearance, except in size. The fatal congestions were in the lungs, as the symptoms indicated.

2. Another case from the same gentleman: A soldier, who had labored under chronic diarrhœa, was taken in the morning, and died at night. His brain seemed to be deeply implicated; as he experienced numbness, had a vacant gaze, lost the power of speech, and became insensible; but still continued to sit up, until he was about to expire. He was cupped on the neck, had a stream of cold water poured on his head, while his feet were immersed in a hot bath, and took large doses of the sulphate of quinine and carbonate of ammonia — all without effect. *Post mortem appearances.*—The external parts of the head were in a state of congestion, and the brain was covered with engorged vessels, but its substance showed very little hyperæmia. The lungs were moderately engorged. The stomach and bowels showed traces of inflammation. As this patient had labored under chronic diarrhœa, it may be presumed that the latter condition existed before the fatal attack.

3. The following observation was given me by Doctor Boling and Doctor Baldwin, of Montgomery, Alabama: A man had the characteristic symptoms, but the fits were so mild, that he rose from his bed, and 'kept about' between them, for five or six days. The fatal paroxysm then came on, and he died in twenty-four hours. During the disease, his tongue was dry, smooth in the middle, furred on each side, and red at the edges and tip. *Post mortem appearances.*—His stomach was empty. In its greater curvature, near the pylorus, patches of hyperæmia, with softening. The small intestines, particularly the lower part of the ilium, exhibited the same appearance. The spleen and liver were healthy.

4. I am indebted to Doctor Sims, of the same city, for the following: A man, not attended by him, was said to have died in the second or third paroxysm, with the usual symptoms. The dissection was commenced before the body had entirely lost its heat. The lungs, liver, and spleen, with all the venous trunks connected with them, were distended with uncommonly dark blood. The stomach contained the medicines, not spread over it, but was natural in appearance, and so were the bowels; but near the ilio-cœcal

valve, there was a quantity of black, tar-like matter, similar to the contents of the gall-bladder.

5. Doctor Pennick, of Wetumpka, Alabama, observed the following case: A man was taken with what appeared to be an ordinary chill, but became dizzy; and falling, cut his scalp through to the skull. In the first fit, his breathing was embarrassed; in the second, it became stertorous, and he died. On examination, his brain was found in a state of congestion, with serum in the ventricles. The mucous membrane of the stomach, exhibited a spot of a dark, modena-red color, and that of the bowels, two others of the same kind.

6. Several physicians, of Greensboro', Alabama, in the course of their joint conversation with me, on malignant intermittents, mentioned two *post mortem* inspections, which they had witnessed. In one, there was considerable engorgement of the brain; in the other, a great congestion and enlargement of the spleen. The splenic region was tender, before death. No other morbid appearances were recollected.

7. Doctor Haywood, of Tuscaloosa, in the same State, informed me, that he had made a number of dissections of persons dying of this fever, in which he could detect no morbid appearance, except, in a part of them, a slight hyperæmia of the mucous membrane of the stomach, which he supposed to have been produced by medicines.

8. Doctor Echols, of Selma, in the State just mentioned, informed me, that he had examined several who had died of the disease, without finding any morbid appearances, except enlarged spleens in a part of them.

9. Doctor Christian, of Memphis, Tennessee, had examined a few subjects, in which he found the stomach but little altered; in one case (which must have been protracted), the liver was suppurating; in others that organ was enlarged; in most of them the spleen and brain were engorged.

10. Doctor Frye, of Peoria, Illinois, had examined two subjects, dead from the same fever. One of the patients had labored under incessant and uncontrollable vomiting. The stomach and liver were found in a state of congestion. The spleen was enlarged and softened.

11. Doctor Ridgely, of Cincinnati, examined the abdominal organs of a boy five years old (*see page* 764), who died of the Fever, and found the stomach and bowels free from lesion; the liver was unusually firm, and of a leaden hue; the spleen enlarged, engorged, and of a dark color.

12. A gentleman, living in the interior of Indiana, had his constitution impaired by several attacks of the Fever. Three years elapsed without any, though he continued in the same locality; but he was none of the time in perfect health. He then undertook a summer visit to Cincinnati; and, on the way, had a malignant paroxysm. On reaching the city it recurred, and Doctor Ridgely was called in. He found the skin of the patient cold, and of a dark and dirty copper hue, which it had exhibited for sometime before; his pulse was feeble and rapid; his mind wandering, with short periods of drowsiness. In a few hours he expired. A *post mortem* inspection revealed the following lesions: The lungs slightly engorged; heart softened and

apparently atrophied; mucous coat of the stomach and bowels softened; liver somewhat enlarged, tender, and friable; spleen enlarged, and almost decomposed into a grumous mass. Finally, a most offensive putrefaction followed in a few hours after death. In this case, no doubt, many of the lesions had been produced by previous attacks of the Fever.

Although these observations offer very little that meets the demands of exact pathology, seeing that the brain and spinal cord, with a few exceptions in favor of the former, were not examined, and that the lesions of the other organs are given in a vague and general manner, still they are not altogether valueless, and we may devote a paragraph to their generalization.

1. In several cases, very few traces of disease were found. The patients died from nervous depression; and whatever congestions may have been formed, nearly disappeared, while the patient was *in articulo mortis.*

2. In the cases in which the brain was examined, it was generally found in a state of congestion; which is, perhaps, its invariable condition in soporose cases.

3. In the first case, characterized by pulmonary symptoms, the lungs were found in a state of great congestion; and, in several others, they were more or less in that condition.

4. The stomach and bowels in each patient were in nearly the same degree of lesion; but in none were the traces of disease great. In several those organs were natural; in about an equal number more or less congestion existed; but in two or three only was it regarded as inflammatory.

5. The liver, in several of these subjects, exhibited signs of congestion; in others it was quite natural; in one suppurating; in another dense to the touch; both of which conditions probably existed before the attacks, of which the patients died.

6. The spleen was, on the whole, oftener affected than any other organ; but in one case it was reported natural; in several, not mentioned; when we may presume it was in the same condition; in a majority of the subjects, it was engorged and enlarged.

To sum up, we may say, that the signs of inflammation were few and uncertain; that passive congestions were common; that they occurred in the brain and lungs, but still oftener in the abdominal organs; above all, in the spleen; but that no organ was always affected, and consequently that none, according to these observations, is the invariable and characteristic seat of lesion.

SECTION IV.

PATHOLOGICAL ANATOMY OF REMITTENT FEVER.

I. A remark already made, concerning our knowledge of the lesions of structure in simple intermittents, is, to a certain extent, applicable to simple remittents. As they generally terminate in health, we can only judge from the symptoms, what organ or organs are especially affected. In many cases they degenerate or change into agues; and in time bring about the visceral derangements, consequent on chronic intermittents. But simple remittents have a mode of termination which distinguishes them from all intermittents. It is the typhous state or stage. In this metamorphic fever, the brain is always affected, either with simple hyperæmia, mere irritation, or inflammation. When coma, supervening at an early period of the change, is the prominent symptom, the first of these pathological conditions, is perhaps predominant; when the supervention of cerebral symptoms has been sudden; and they consist of coma-vigil and delirium, with feeble and frequent pulse, active subsultus tendinum, and a locomotive propensity, the second or irritable state of the brain exists; when the vigilance becomes morbid, with wild, loquacious, and singing delirium, cold feet, hot forehead, red eyes, contracted pupils, pulsating carotids, and more or less subsultus, with efforts at locomotion, inflammation may be assumed to exist; yet I have seen these symptoms, not excepting a closely contracted pupil, immediately relieved, and recovery follow a large dose of laudanum; proving that they may depend on irritation only. Nevertheless, it may, I think, be received as a fact, that when patients die in what is called the typhous stage of simple remittent fever, it is generally from cerebritis; and that, after death, the principal lesions would be found in the brain, in the form of hyperæmias, and serous or fibrinous secretions; to which softening, perhaps, may sometimes be added. This cerebritis, however, cannot be admitted as an original affection, characteristic of the Fever.

But we must turn from the brain to other organs. The lungs, it is well known, are liable to inflammation in this fever; and instead of occurring late in the disease, like cerebritis, it generally arises at an early period. Such inflammation may prove fatal; and then a post mortem inspection will show the lesions resulting from bronchitis or pleurisy; but more frequently still those of pneumonia, such as sanguineous engorgement and hepatization. But they cannot be regarded as constant, essential, or characteristic of autumnal fever; for, *first*, a vast majority of cases, even those which prove fatal, do not present a single symptom of pulmonary inflammation; and, *second*, this inflammation, in most instances, is the undoubted effect of the sudden changes of weather in the latter part of autumn; and must, therefore, be taken as the offspring of an incidental cause, acting subsequently to that which produced the Fever.

We are, thus, driven to the abdominal viscera, in our search after a lesion which may enter into the definition of remittent fever; and, which, being shown by symptoms during life, must be found by dissection after death. In all times and places, it has been observed, that this fever is accompanied, from the beginning, with functional derangements of the abdominal organs; and, in many cases, there are unmistakable symptoms of inflammation. The functional disturbances are found chiefly in the liver, stomach, and duodenum. To speak of functional disorders of the spleen, when we know not what its function is, would be an absurdity. Should the life of the patient be destroyed, while mere functional derangements prevailed, no morbid appearances might be found after death. They are but perturbations of the innervation, which carry into the circulation and secretions an altered action, different from that of inflammation. In simple remittents these disruptions of function may continue without generating derangements of structure, until the fever spontaneously ceases, or is reduced by art; in the highest grade of malignant remittent fever, the irritation and prostration of the whole nervous system may be so intense as to destroy life in two or three paroxysms, leaving no lesions of structure to be revealed by the knife.

But abdominal inflammation does occur in both inflammatory and malignant remittents. Moreover, it often commences with, or early in the Fever, and declares itself by legitimate signs. It arises independently of any coöperative or exciting cause; and, therefore, results from the same agency with the Fever. Finally, by its ravages, it shows itself, to the anatomist after death. But is it always in the same part? It is not. There are three organs in which it is chiefly found. They are the spleen, gastro-duodenal mucous membrane, and liver. Occasionally it invades the whole at the same time; but oftener limits itself to two, and, in many cases, affects one only. None of them is affected in some cases; and, therefore, there is no *inflammatory* lesion in the abdominal viscera, which constitutes a peculiar anatomical character of remittent fever; any more than there is an ever present uniform lesion in those who die of intermittent fever. But we must proceed to inquire into the evidences afforded by autopsic examinations.

II. POST MORTEM REVELATIONS. — The facts supplied by our Valley, for illustrating the pathological anatomy of remitting fever, are still fewer than for our intermittents. I am compelled, therefore, to look abroad; but, am sorry that in doing so, I cannot find materials for a very full and satisfactory history.

At all times, occasional examinations have been made in Europe, the Atlantic States, and the Interior Valley; but they only announced, in general terms, the existence of congestion, softening, and inflammation, found in different cases, in all the organs of the cranium, thorax, and abdomen. A series of careful post mortem inspections, by an able pathologist, was still wanting; and, a few years since, Doctor Stewardson undertook to supply the desideratum.* His dissections, seven in number, were made in the Pennsylvania Hospital, in the months of August, September, and October, which constitute the true period of prevalence of this fever.

The following is his summary of the pathological appearances:

"*Brain.* — This organ was examined in only five of the cases. The sub-arachnoid effusion was either entirely wanting, or moderate, except in one case, where there was a considerable quantity of reddish serum. In the same case the ventricles contained an ounce of bloody serum, whilst in two of the others they were empty, in a third nearly so, and in the fourth contained scarcely a drachm of fluid. In one the walls of the ventricles were of a

*American Journal of the Medical Sciences, for 1841 and 1842.

yellow color. The pia mater was deeply injected in one case, in which also there appeared to be a slight effusion of blood into the cells in a small circumscribed space; its veins much distended posteriorly in another. The cortical substance was of a deep shade in two cases, and in none is it mentioned as being paler than natural or presenting other alteration. In two cases the medullary substance was natural; in a third it felt pasty without giving the sensation of softness; while in a fourth it was soft and pasty, being at the same time dry and of a milk-white color, with few bloody points. In a fifth its color was a dirty white, mixed with a faint reddish brown, its consistence natural, with the exception of slight central softening. The same condition was presented by the cerebellum, which was natural in three other cases; its condition not noted in the fifth.

"The above alterations are similar to those found in other acute diseases, and must be regarded as slight and comparatively unimportant, if we except the individual in whom there was large bloody effusion in the ventricles, etc., and whose case will be reported further on.

"*Respiratory Apparatus — Pleuræ.* — Old adhesions were found in a few cases, but very limited in extent. In two instances there was effusion in each pleural cavity, of about half a pint of a reddish brown or bloody fluid. In both of these cases the heart was flaccid, its lining membrane deep red or reddish brown, and in one the pericardium also contained several ounces of bloody serum. The lungs, on the contrary, in one of these cases, were healthy, in the other, very dark, deeply congested, without hepatization. It is most likely, then, that the pleural effusion was the result rather of an altered condition of the blood, combined, perhaps, with some softening of the tissue, than upon obstruction to the pulmonary circulation. That pleural effusion was generally absent or slight in the other cases, I have little doubt, but its absence is not positively noted.

"*Lungs.* — Of the six cases in which these organs are particularly described, hepatization was found in one case only, and that at the summit merely of the middle lobe. They were generally more or less supple and crepitant, sometimes dark posteriorly; in one instance yellowish in the upper lobes, but deep reddish brown in the lower, in which case also spumous fluid of corresponding color, but most abundant in the lower lobes, issued from the several parts when squeezed. Indeed these organs presented nothing particularly remarkable, except in one instance (Case III), where they were highly congested, their color throughout nearly their whole extent being very dark, almost black, and the tissue but slightly crepitant, though not granulated or very easily penetrated.

"The condition of the lungs, then, was much the same as in most other acute diseases, not especially seated in these organs. It is worthy of remark, that in no instance were there any of those hæmorrhagic masses frequently occurring in the yellow fever, according to the description given us by M. Louis, while, in both, hepatization was very rare.

"*Circulatory Organs.* — The pericardium contained a small quantity of serum in one case, and several ounces of bloody serum in another.

"*Heart.*— This organ was flabby in three of the six cases in which it is particularly described, and combined with this flabbyness, there was diminished consistence at least in two cases. In the same three cases its lining membrane was reddish brown, deep red, or violet; in two of these the coloring being deepest on the right side and in the neighborhood of the valves, and extending into the pulmonary artery and aorta. In the other three cases the heart presented nothing remarkable; in all, its valves were supple, and in one case of a yellow color. The aorta was of a bright or lemon yellow in two cases.

"In the five cases in which the state of the blood is mentioned, this fluid was found in the cavity of the heart. In one case there were black coagula mixed with red serum; in the others fibrinous coagula, soft in two, semi-transparent and greenish in another, and generally small. No large, firm, fibrinous coagulum was found in a single instance. Although it is impossible to say, at present, whether or no blood in remittent fever presents any characters which are absolutely peculiar, it is perfectly evident that it is the seat of morbid changes which deserve especial attention.

"*Abdomen.*— A few ounces of a bister-colored fluid were found in the peritoneal cavity in one case; in another a part of the peritoneal coat of the gall bladder, and of the neighboring folds of the small intestine were of a rose color, and covered with false membrane. The omentum, and many of the folds of the small intestine, are noted in one case as olive-colored, there being no effusion in the cavity; in another the intestines were of a dingy ash color, and pasty feel.

"*Liver.*— Enlarged in three cases, and in one of them to a great degree; in the others it was of natural or moderate size. The consistence of the organ appears to have been generally diminished, being flabby, or softened, or both, in four cases, a little soft in a fifth, and moderately firm, but still readily penetrated by the finger, in a sixth; in the seventh the consistence is not mentioned.

"The color was nearly the same in every case, but very different from natural. In most of the cases the liver is described as being of the color of bronze, or a mixture of bronze and olive; in one as a dull lead color externally, internally bronzed with a reddish shade; in another as between a brown and an olive, the latter predominating; and finally, as a pale slightly greenish lead color, with a tinge of brown, in one instance. Few things are more difficult than a description of color. The most correct idea of that before us would perhaps be conveyed by stating its predominant character, the same in every case, to be a mixture of gray and olive, the natural reddish brown being entirely extinct, or only faintly to be traced. This alteration existed uniformly or nearly so throughout the whole extent of the organ, except in a single instance, where a part of the left lobe was of the natural reddish brown hue. As the alteration of color pervaded both substances, the two were frequently blended together, and the aspect of the cut surface remarkably uniform. In one case, however, there was a marked distinction of color, the olive being predominant in the parenchyma, the brown in the acini. Of the four cases in which these characters are mentioned, the cut surface is described as smooth in three, of a shagreened appearance, and rough in the left lobe, in the fourth. This last character was evidently dependent upon hypertrophy of the lighter colored substance, which existed also in another instance, both cases, however, being examples of a very protracted form of the disease.

"The nature of the lesion of the liver above described, characterized essentially by a peculiar alteration of color, is not easily determined. That it is the result of inflammation will hardly be contended, and even if attended with congestion (which I think very doubtful), this could not account for it, as congestion is frequently present in other diseases where no such alteration of color is observable, and where, on the contrary, its effect is to produce a deeper red. Some, perhaps, will look upon it as dependent upon the infiltration of bile into the tissue of the organ, but still it will at once be perceived that this presupposes a peculiar alteration of the bile and liver, inasmuch as the appearance presented is not found in other diseases, at least so far as I am aware. In saying that this lesion is found in no other disease, I wish to be understood as excepting those cases of pernicious and other intermittents, which prove fatal in the early stage, or before giving rise to well developed cirrhosis, abdominal effusion, etc. Indeed, I think it highly probable that the same alteration of the liver will be found to exist in intermittents which thus prove fatal; an opinion confirmed by the case last detailed. In speaking, therefore, of this alteration being peculiar to remittent fever, I I wish to be distinctly understood as not excluding intermittent fever, which, in my opinion, is essentially the same disease.

"The lesion in question, then, being peculiar to the disease before us, and the only one which is so (all the other lesions being common to it and other diseases), and at the same time being found, as already observed, in every case, we are obliged to admit that it constitutes its essential anatomical characteristic, or at least that such is the conclusion to be derived from the cases before us. Their number, I am aware, is insufficient to establish such a point conclusively, and it therefore remains for future observers to determine whether or no the lesion we have described belongs to the disease under all circumstances. That such will be found to be the case, I confess, seems to me very probable, when I recollect that the cases we have been examining were distributed over three successive seasons, and originated, not in a single locality, but in different and widely separated places, and also that by a reference to the description of authors, it is apparent that a similar condition of the liver has been frequently observed by them, without, however, attracting that attention which it seems to me it demands.

"Whatever may be the results of future observation in reference to the constant occurrence of this lesion, and even if the conclusion to which I have arrived, that it constitutes the *essential* anatomical characteristic of remittent fever, be found erroneous, owing to its absence in a certain portion of cases, it is still worthy of attention. It certainly constitutes a most peculiar and important anatomical feature of the disease. Its connection with certain symptoms during the early and middle period of the disease, its tendency to pass into cirrhosis in protracted cases, and thus lay the foundation of certain chronic organic alterations, abdominal effusion, etc., and the assistance it must afford in determining in fatal cases the diagnosis between remittent and other fevers, are sufficient to convince us of its claims upon our attention. The striking difference between it and the alteration of the liver which belongs to yellow fever is particularly interesting, especially as it was found quite as strongly marked in the case which most nearly approached to the latter disease, as in any of the others. While in remittent the liver is of a dull bronze or between a gray and olive, in yellow fever it is pale and of various shades of yellow, as straw-yellow, gum-yellow, etc. In typhoid fever the liver appears to present no other change of color than what arises from an increase or diminution of the red tint, being sometimes of a darker red, at others paler than natural."

After Doctor Stewardson, Doctor Power made a number of autopsic observations, on the same fever, in the Baltimore Almshouse. He found the spleen, in every case, enlarged and softened. The liver, was generally, large, soft, and friable; but not in a state of congestion. Its color, in different cases, was grayish-bronze — slaty-bronze, and dark slaty-gray.

Doctor Swett, has since extended these researches, in the New York Hospital.* His cases, five in number, were from the south and west; but not, in general, as well marked as those of Doctor Stewardson. The brain, in most of the subjects, was healthy, although they had delirium and coma during life; the heart was either natural, or flabby and softened; in two cases the lungs showed signs of pneumonia; and taking the whole of the cases together, he found more decided evidence of inflammatory action in them than any other organ. Referring to the stress, which Doctor Stewardson had laid on the pathological condition of the stomach, and bowels, as suggesting, that mucous inflammation is an important and frequent feature of the Fever, Doctor Swett remarks — "I am unable to confirm this opinion. Most of the changes that I have observed in the mucous membrane of the stomach, have appeared to me of a chronic nature; and probably long antecedent to, and entirely independent of the acute disease. I refer, particularly, to the thickened and mammillated condition of the organ. The injection of the mucous membrane, although present in all the cases to a certain extent, did not appear to me, beyond what is commonly noticed in other acute diseases, and might, in some cases at least, be referred distinctly to simple post mortem venous congestion. The symptoms during life, appear to me, to strengthen this idea. The patients very seldom complained of pain in the region of the stomach, and although slight tenderness on pressure was frequently noticed, yet this did not exceed, I think, what is noticed with equal frequency, in other febrile affections."

"Doctor Stewardson, also remarks, that traces of inflammation exist on the mucous membrane of the duodenum, and notices particularly, an enlarged

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* American Journal, Medical School, for January, 1845.

condition of the mucous follicles. This view, also, I have been unable to confirm." * * * "The mucous membrane of the intestinal canal, excluding the evidences of chronic disease, or of disease that had probably for a long time ceased to exist, was found healthy. The symptoms during life confirmed this opinion. The absence of diarrhœa, of abdominal pain, and tenderness, of tympanitis, the ease, and even the feeling of relief with which purgatives acted, all go to prove the absence of at least, inflammation in those important organs."

In every subject, the spleen was more or less enlarged, and engorged — in some softened. The state of the liver will be best given in his own words. "It will be perceived that, in the five cases above detailed, the peculiar condition of the *liver*, which Doctor Stewardson has assumed as the *anatomical characteristic* of remittent fever, was uniformly found." * * * "Two important considerations naturally present themselves here. *First*, what is the nature of this condition of the liver? The only positive change that I have been able to observe, is that of color — the slaty, and bronze tint externally, the olive tint internally. It is true that a slight degree of softening of the tissues seems to exist, in connection with this change of color, but this has, in all my cases, been very moderate in degree, and, in one of the best marked cases of the disease, extremely doubtful. All will admit, I think, who have examined such cases, that there is no evidence of inflammation in the changes noticed, for although some degree of capillary injection existed in two of the cases, yet in the remaining three it was entirely absent. The natural size of the liver, the absence of lymph or pus, the small quantity of blood yielded by pressure, as well as the local symptoms during life, especially the absence of pain and tenderness over the region of the liver, tend to confirm the same idea. It appears to me, not an unreasonable conclusion, to suppose that the change of color is produced by the action of the bile, especially, when we remember the appearance of this secretion as observed in the gall-bladder.

"Another important fact to establish is, whether this appearance of the liver may not be found in other diseases, and particularly in other forms of fever. This question can only be settled by long and multiplied observation. I can only say that, in six fatal cases of continued fever, four of which originated on ship-board, and two in this city, no such condition was found, and that, after careful examination with this object in view."

My own occasional autopsies, have afforded results, which correspond very well with those which have been detailed; but I must confess that my attention was not attracted to the *peculiar* color of the liver, first distinctly pointed out, I believe, by Doctor Stewardson; though a modification of color in that organ, had been often mentioned before. Doctor Swett has intimated, that such a change might be looked for, in the organ which secretes the bile. We know, that green discharges are not uncommon, and a bluish fluid is occasionally ejected. Doctor Hollingsworth, of Mississippi, has communicated to me a case, in which, for many days, the patient continued to have copious evacuations of that hue. As the febrile action in this fever is of a peculiar kind, it is reasonable to suppose, that the organ charged with forming the yellow coloring matter of the bile, may produce a tint of a different kind. Thus, the change of complexion, does not, necessarily, require us to infer a structural lesion of the liver. In fact, apart from the altered hue, the liver is, apparently, much less affected than the spleen. Another evidence, that it is not always deeply implicated, is to be found in the fact, that during many remittents, there are daily discharges of healthy-looking, yellow bile; and, that during convalescence, the organ generally acts very well; finally, that fewer hepatic, than splenic diseases, follow on the Fever. The results which have been recounted, show that the spleen is, generally, if not always, involved; and the mucous membrane of the stomach and bowels very frequently.

But the admitted ravages of inflammation, are neither constant nor striking:—not sufficient, I think, in most instances, to account for the death of the patient; unless we include among them, all cases of congestion and softening; which would certainly be gratuitous. Passive hyperæmia, is an unquestionable pathological fact; and fever softens every tissue of the body. To the latter type of morbid action, we may refer the soft and flabby state of the heart, not less than of the liver, spleen, and mucous membrane of the stomach, and duodenum. In a case communicated to Doctor Stewardson, by Doctor Howland, of Baltimore, the spleen did not bear lifting, any better than a clot of drawn blood bears it; and many others have observed the same phenomenon; which indicates a decomposition of the vascular and fibrous tissues of the organ. The soft and pulpy state of the mucous membrane, with but little appearance of hyperæmia, is doubtless, of a febrile, rather than phlogistic origin. In a post mortem examination, by Doctor Harper, which I attended, at the Vicksburg Hospital, in 1844, the mucous membrane of the stomach, was soft, tender, thickened, and easily detached; but there was only here and there a spot of hyperæmia. It is worthy of remark, that the duodenum in this case, was sound.

We may, on the whole, conclude, that although, more or less inflammation arises, perhaps in every severe and protracted case of this fever, and may often be the cause of death, it is not necessary to the *existence* of the Fever; which in many cases proves fatal, independently of the lesions, which in others it produces.

SECTION V.

CONSEQUENCES OF AUTUMNAL FEVER.

I. Chronic action of the Cause of Autumnal Fever. — This seems to be a suitable place, in which to inquire, whether the cause of autumnal fever can act upon the system, to the production of morbid conditions, other than the Fever itself. There are etiological agents, as the variolous poison, which either produce no effect, or occasion a full development of the disease; there are others, equally specific, as that of epidemic cholera, which affect the system with every grade of violence, from the slightest diarrhœa, to mortal collapse; finally, there are others still, as vicissitudes of weather, which produce in one person catarrh, in a second, tonsilitis, in a third, rheumatism, in a fourth, a fit of dyspepsia. There is, then, no objection, *a priori*, to the opinion, that the cause of autumnal fever may exert injurious influences of a lower grade, and a different kind, from that Fever. Whether such be the fact, can only be known by observation.

That the agent we are now considering, can act in a gradual and feeble manner, to the end of slowly developing intermittent maladies of a mild character, is what I can testify; and as the consequences of autumnal fever, as found in different parts of the body, we may, I think, conclude, that the slow and insidious operation of the noxious agent, may generate various diseases, or at least, diatheses and predispositions to them. But for the full illustration of this subject, a more ample store of facts, than I possess, is required.

Over most of the Interior Valley, a ruddy complexion is rare; and often replaced by a slight turbid hue, or a tinge of sallowness. When standing before the medical classes of Lexington, Louisville, and Cincinnati, composed chiefly of young men between twenty and thirty years of age, I have seen very few, with plump and rosy cheeks. In general, the malar bones appear prominent, from defective cellular development of the cheeks. These deficiencies exist in various degrees; and are greatest among the people in what are called malarial districts. When we mingle with them, we see conclusive evidence, that their physiology is not sound, although they may regard themselves as in health. Those of the worst aspect, have generally experienced one or more attacks of fever, which have left them infirm; but others have never suffered from that disease, and yet they are not vigorous, in appearance or reality. They who have constantly breathed the atmosphere of such localities, and have suffered attacks of fever while young, are often stunted in their growth, and never reach the port or portraiture of perfect manhood. But before we ascribe these effects to an empoisoned atmosphere, only, we must recollect that heat and moisture generally prevail in such localities; and grant, that an undefinable portion of the injury, should be attributed to them.

If we admit the reality of what has been set forth, and connect with it, a periscope of the Valley, but recently become the abode of civilized man — as yet, in its oldest settled portions, but in the transition state — many parts abounding in swamps — others intersected with alluvial streams, and almost everywhere overshadowed with forests, we may presume, that a national physiology, with its peculiar infirmities and predispositions, is, or must, necessarily, be the consequence. This, if I mistake not, is actually the case at the present time; and constitutes a reason, why bloodletting and other active evacuations, are not borne as well, by those who live in low paludal districts, as those who inhabit higher and dryer localities. In the former, many diseases, not inherently periodical, display more or less of that type; evincing that the constitutions of the inhabitants, have been acted upon by the cause of autumnal fever.

II. But we must inquire whether the people in such places are liable to any *actual* diseases, periodical fevers excepted, which may be regarded as the products of the conditions under which they live.

Comparing the early and the latter frequency of biliary derangements, in the same localities, it seems to me, that with the progress of cultivation, and the density of population, the present has a decided advantage over the past; and a comparison of country and city, leads to the same conclusion. In former times, I have witnessed, more than once, an epidemic jaundice, in autumn, which it appeared natural to refer, to the cause which produced fever, in that season. Dyspepsia has, also, seemed in many cases, to be the offspring of the same agency. Chronic, or subacute hepatitis, I am almost convinced, has often been generated by the same agencies; and it is an admitted fact, that the spleen may become enlarged in these localities, without the previous occurrence of a single paroxysm of fever.

Finally, not to press a debatable principle to its utmost limits, I will only add, that neuralgias, and many irritations and oppressions of the brain and nervous system, unattended with pain, appear to be insidiously generated by the same influence; in illustration of which, I may introduce the following statement, made out from *memoranda* handed me by a gentleman of this city.

Mr. N. L., who had, for many years, resided in the eastern part of the city, near the junction of Deer Creek with the Ohio River, and, consequently, in what is called a malarial atmosphere; became affected with dyspepsia, from which he had been exempt through the earlier period of life, when that disease generally occurs. His feelings became depressed and irritable, his strength declined, and he gradually lost much of his flesh. At length, under a full and nutritious diet, and the daily use of wine or brandy, those symptoms were removed; and he recovered his cheerfulness, strength, and flesh. Some time afterward, however, he began occasionally, to experience, in the night, the premonitory feelings of a paroxysm of dyspepsia, succeeded in the morning, by vertigo, and a momentary loss of consciousness, followed by transient perspiration. These fits usually returned several times for a day or two, when a slight diarrhœa would supervene, and terminate the attack. After seven or eight months, it struck him, that the disorder had been recurring at regular periods; whereupon he determined to record the times of future returns, and soon found the periods to be, invariably, of thirty days. Becoming familiarized to them, and being a man of talents and observation, he noted, that every paroxysm was ushered in by a peculiar vision of the mind, so that, at length, he would exclaim, 'there is the same strange idea,' but the instant it was gone, 'he never could have the least recollection of what it was.' This continued for more than a year. Medicines then checked the paroxysm for one or two monthly periods, when it recurred, as severe as before, every twenty-one days, and continued at that rate, for five or six months; when, under the use of medicines, the recurrence came to be on the sixteenth day, the violence of the fit remaining the same. Throughout the second night after the access of the paroxysm, he would invariably lie awake, but was calm in mind, and without fever. For more than two years, he continued to note the recurrences of the fit, and found them constantly on the sixteenth day. During that period, as soon as the paroxysm was gone, he felt well, and his mind was clear and active; but gradually, it became so enfeebled and gloomy, that he made no further records. After about five years, the fits began to abate in violence; and to become irregular in recurrence, sometimes not returning for six weeks. At the present time, when he is sixty-five years of age, they still recur, but with great mitigation. He is never kept awake through the night, nor does he any longer lose his consciousness. His health, is otherwise, good, and no impairment of memory or intellect seems to have been produced.

III. Consequences of Autumnal Fever.—The reader will perceive, that a distinction is made between the slowly developed effects of the agent which produces autumnal fever, and the morbid states or consequences which follow it. As an illustrative contrast, I may anticipate what must be repeated hereafter, and say, that yellow fever, even when not skillfully treated, leaves but few vestiges behind. Death, or sound, even improved, health, is the fate or fortune of the patient. It is far different with the subject of autumnal fever. When combatted with skill, in its early stages, his recovery, it is true, may be perfect, and this, in mild remittents, may be the case, if no medical aid be administered; but no fact is better established, than that many cases are followed by consequences, from which patients slowly recover, or finally die. Some of these lesions are found in the innervation; and manifest themselves as neuralgias in various parts of the body; others exist in the blood, which remains impoverished; others in the exhalent and absorbent vessels, generating dropsies; others in the stomach and bowels, originating dyspepsia, diarrhœa, or constipation; others in the liver, which may remain torpid or inflamed, with an attendant jaundice; lastly, others in the spleen, left inflamed or enlarged and softened. These various secondary and tertiary lesions, must be studied, to complete the pathological and therapeutic history of the Fever; and to them we must now give attention, beginning with the most frequent and formidable—the disorders of the spleen.

CHAPTER XI.

CONSEQUENCES OF AUTUMNAL FEVER.

SECTION I.

DISEASES OF THE SPLEEN:—GENERAL VIEWS.

I. It is, I think, an unquestionable fact, that a vast majority of the people of this country, if not of our race, live and die, without experiencing any disease of the organ we are now considering. Abuses of diet, which carry a morbid condition into the alimentary canal, liver, kidneys, heart, and brain, do not, as far as we know, often disturb the spleen. Alcoholic potations, which light up inflammations in the same organs, and above all in the liver, leave the spleen unaffected. Vicissitudes of temperature, which inflame all the pulmonary tissues, the peritoneum, and the joints, are not known to occasion splenitis. All the viscera enumerated, may, moreover, be inflamed, or otherwise diseased, without necessarily carrying into this deeply caverned, and unsocial organ, any recognized, sympathetic disturbance.

This exemption, from the sinister influence of many external and pathological causes, may, perhaps, be ascribed, in part at least, to the following causes:

1. The organ is placed more beyond the influence of external agents than any other abdominal viscus, except the pancreas; which, at the same time, it may be remarked, is still more exempt from disease than the spleen. The spleen is also more secluded from outward influences, than the lungs, heart, and brain.

2. Its tissues are few and simple, consisting chiefly, of arteries, veins, a fibrous, or cellulo-fibrous membrane, containing a red pulpy matter, and an external fibro-serous tunic. Now the simpler the structure of an organ, *cæteris paribus*, the fewer are its diseases.

3. The few nerves which enter it, upon the vessels, are derived from the system of the great sympathetic, and do not bestow on it much animal sensibility; nor establish between it and the other organs of the body any lively sympathy.

4. Compared with most of the organs, its function is, manifestly, more simple than theirs. What that function is, we do not know; but, it is, evidently, limited to the blood; which it is either designed to receive and retain, from the other organs in certain excited states of the circulation, as suggested long since by Doctor Rush; or it works out some change in the constitution of that fluid, or both; functions, especially the former, requiring far less complication of structure, than the office of the liver, lungs, or brain.

II. I shall not stop to inquire into the relative influence of these different anatomical and physiological reasons, for the comparative exemption of this organ from original disease; but proceed to remark, that while this exemption is a fact, that must be admitted, there are three forms of fever, which carry disease into that organ. I say *three* forms, for all fevers do not. Thus, most or all, of the phlegmasiæ, may run on with extreme violence for many days, or, in a subacute grade, for weeks, without occasioning disorder of the spleen; while, on the other hand, two of the forms of fever to which I allude, very often, and the third, almost constantly, affect it; they are yellow, typhous, and autumnal fever.

1. Dissections have shown, that the spleen is sometimes enlarged, and softened in yellow fever, but these lesions are not even so frequent as in typhous and autumnal fever.

2. The typhoid fever of the French writers, occasions derangement of the spleen, as one of its most common characteristics. They are not generally known, however, during life, though sufficiently manifest after death. They have not only been observed in Paris, but in various parts of the United States. They consist of enlargement and softening, without, in most cases, many of the more common and certain signs of inflammation; neither pus being found within, nor coagulating lymph without the organ. The variety of fever, properly denominated typhous, also presents us, in fatal cases, with lesions of the spleen, though less frequently, and strikingly, than the typhoid.

It is worthy of remark, that yellow and typhous fevers, do not, in cases of recovery, leave behind them, as consequences, either splenitis or enlargement of the organ; showing that they affect it differently from autumnal fever. I have never yet seen an enlarged spleen, following on any form of typhus. There is nothing, then, to be said as to the treatment of diseases of the spleen, consequent on these continued fevers.

3. The great source of diseases of the spleen, in this country, is well known to be autumnal fever. In the present state of our knowledge, it would, perhaps, be most proper to content ourselves with the knowledge of this connection, as a fact, and not attempt to speculate upon it. Nevertheless, it can do no harm to review the suggestions which have been made, if we do not rest any treatment upon a mere hypothesis.

a. It has been conjectured, that autumnal fever commences in the spleen; whence a morbid action spreads itself throughout the organism. But if this were the case, we ought to find that organ diseased *before* any other; which, as far as we can judge by symptoms, is not the case. As remittent fever, moreover, is generally more violent and dangerous than intermittent, the signs of disease in the spleen should be more decided in the former than the latter; which we all know is precisely the reverse of the fact. Finally, the manifestations of splenic disease, are often greatest on the decline of the Fever, which is directly opposed to what should be the case, if the Fever arose from the disease of that organ.

b. It has been conjectured, that in these fevers, the spleen becomes involved, during the cold stage, from a recess of the blood from the exterior parts of the body, and its accumulation in the portal circle. Such a destruction of the equilibrium of the circulation, must be admitted as a pathological fact; and that it is a cause of the disorders of that organ, may be inferred from another fact, which is, that remittents, in which the cold stage is less violent and protracted than in intermittents, disorder the spleen much less, than the latter. On the other hand, however, typhoid fever injures the spleen frequently and seriously, although it be a continued fever; and, of course, is exempt from those periodical revulsions, which characterize intermittents; and hectic fever, attended with protracted diurnal chilliness, continues for a long time, without occasioning disease of the spleen.

c. A third hypothesis, is, that malaria, or whatever may be the remote cause of autumnal fever, has a specific tendency to act on the spleen; just as the remote cause of typhoid fever directs its influence on the glands of Peyer, and the remote cause of plague, on the ganglia and other organs of the axilla and groin. I think it can scarcely be doubted, that this is a reality. For, *first.* The great frequency of splenic disorders in autumnal fever, would seem to prove it. *Second.* The influence of the sulphate of quinine, in removing some of them, looks to the same conclusion. *Third.* In paludal districts, the spleen sometimes becomes disordered, by the slow or feeble action of some agent, the individual never having had an attack of either intermittent or remittent fever.

d. It is well known, that diseases of the spleen, are almost incurable while the individual continues to reside in the locality which generated them; but are curable, and sometimes spontaneously cease, when he seeks a more salubrious residence.

On the whole, we may, perhaps, combine two of these hypotheses and say, that the spleen is not only engorged during the cold stage, but that it is the nature of the remote cause of autumnal fever, to determine a morbid influence on that organ, more than any other; and hence the frequency of its disorders in autumnal fever. We must not, however, lose sight of the fact, that we are entirely ignorant of the function, which is performed by or in, the red pulpy matter of the spleen; that we know nothing of the relations which it bears to the blood; nor of the influence of the remote cause upon the blood; and, therefore, that the disorders of the organ may, possibly, be induced through those humoral elements.

In persons of strumous habit, the spleen is apt, like almost every other organ, to become the seat of tubercle; but passing this by, we may say, that almost every case of disease of that viscus, known to us in this country, grows out of autumnal fever; and, in what I shall say through the remainder of this section, I propose to limit myself to its disorders consequent on that fever, most of which, moreover, connect themselves with the intermittent form.

III. Simple intermittents, if protracted, scarcely ever fail to disorder the spleen. Such disorder at first shows but few signs of an inflammatory character, presenting nothing but enlargement; but, in the succeeding winter, under vicissitudes of temperature, inflammation may be superadded. Of the true nature of this simple enlargement, we know nothing very positively; but it must consist, I think, either in an increase of the peculiar pulpy matter of the organ, with increased development of the fibrous structure; or the accumulation and stasis of the blood, or both. To the former, only, should the term hypertrophy be applied. The latter is a species of permanent erection, and I presume it is by far the more common of the two. I once supposed, it might sometimes be a hydropic condition of the organ, or a secretion of serum into the cells of the spleen, where it would be colored by the red pulpy matter; but can cite no facts in support of this conjecture.

During the paroxysms of a malignant intermittent, this organ suffers severely. This is proved by two facts. *First.* Those who recover are often left with enlargement of the spleen, although they might have had but two or three paroxysms. *Second.* The organ in those who die, is almost always found more or less swollen, greatly softened, and sometimes almost diffluent; but it rarely exhibits any acknowledged vestiges of inflammation.

Inflammatory intermittents generate most of the cases of splenitis, with which we meet. This inflammation may be accompanied by manifest swelling of the organ, or exist without it — it may, again, be either serous or parenchymatous. It may invest the organ with bands of lymph; or fill it with factitious tissue, thereby hardening it; may soften it in the absence of such tissue; or may end in suppuration. It may manifest itself, during the Fever, as a decided complication, and cease with it; or, escaping observation in the midst of the general overthrow of the functions, may attract our attention, for the first time, when the patient has begun to convalesce. In whatever stage of the Fever, or the convalescence, it may be developed, its diagnosis is essentially the same. This, when enlargement and inflammation are combined, is comparatively easy; but when inflammation exists without enlargement, the diagnostic difficulty is sometimes considerable.

We come now, to consider the symptoms and treatment of splenitis.

SECTION II.

SPLENITIS.

I. Symptoms. — These, as they occur during an attack of inflammatory intermittent fever, have been stated on *page* 752, and therefore, a brief recognition will, now, be all that is necessary. The characteristic symptoms are pain, not often very acute, in the left hypochondrium; tenderness or soreness on pressure, over the intercostal spaces, or below and behind the cartilages of the ribs; frequently, a hacking cough; a sense of oppression and anguish in the region of the diaphragm; sometimes a hiccup — two examples of which were mentioned to me, as occurring in their practice, by

Doctors Henry, and Merriman, of Illinois; in violent cases, a pain in the left shoulder, of which, Professor Gross* has met with one example; and I have myself seen two or three; finally, more or less fever, according to the degree of inflammation. To complete the diagnosis, the absence of several symptoms, must be noted. The stomach and bowels are much less affected in splenitis, than in hepatitis; there is no expectoration, and the respiratory murmur, can be heard over the splenic region; but when the organ is enlarged, which is almost invariably the case, there is a dull sound under percussion; finally, the patient can lie on the opposite side, much better than in hepatitis.

II. MORBID ANATOMY. — Splenitis may be either capsular or parenchymatous. I know of no distinguishing symptoms; but, from analogy, we may presume, that the former variety is accompanied by greater pain and tenderness, than the latter. The effect of the first, is to throw out coagulable lymph; which more or less invests the organ, producing, by its contraction, deformity and, sometimes, atrophy of that organ, examples of which I have seen in the Louisville Hospital. The effect of the second, in some cases, is induration of the organ from infiltrations of lymph; in others, softening, or suppuration.

Occasionally, the spleen becomes adherent to the diaphragm; the inflammation may then permeate the latter, and enter the pleura and lungs, which will attach themselves to it above. Thus, splenitis, diaphragmitis, pleurisy, and pneumonia, may finally coëxist; and, if the physician should not be called till the last is established, he might pronounce it the only disease. This extension of the inflammation to the diaphragm, explains the production of cough and hiccup, in splenitis; and affords a beautiful example of the influence of an inflamed surface, in exciting its own morbid condition in another surface, with which it is in contact.

III. EXCITING CAUSES. — The cases of splenitis now under consideration, are those which follow on autumnal fever, especially inflammatory intermittents. Beginning in the early stages, the inflammation may survive the cessation of that fever; but in other cases, the organ is only brought into a state of sanguineous engorgement by the Fever, and the inflammation is awakened by an exciting cause. This is generally one of those sudden changes of weather, which are so frequent in our middle and higher latitudes, where it is more common than in the South. Being thus awakened, it generally occurs late in autumn, and through the following winter. But violent exercise may start the inflammation, when the organ is in a state of congestion. Lastly, an accidental blow or a fall, on the left side, may bring out the same result.

IV. TREATMENT. — The fever which accompanies splenitis, very commonly displays a remitting type; and this paroxysmal character has often restrained the physician from active antiphlogistic measures, when they were imperatively demanded. In our warmer climates it may not be admissible, in most

* Pathological Anatomy, Second Edition, p. 677.

cases, to employ the lancet; but, in the cold and variable, venesection is indispensable; the blood is sizy, and much relief follows its detraction. A case in the Commercial Hospital, of this city, during the present winter, required no less than four bleedings, after each of which the symptoms were mitigated; and the swelling of the organ, which was so great as to cause a bulging out of the cartilages of the ribs, was, also, diminished by every operation. In mild cases, and especially, when the constitution is much broken down, cupping over and below the ribs, may answer the end proposed by the loss of blood; after which the counter irritation of a large blister will be useful. In acute cases, calomel, in two grain doses, may be given every two hours, for a few days, the bowels having been previously evacuated, or, in its stead, active chologogue and hydrogogue purging may be effected by the compound power of jalap, infusion of senna with sulphate of magnesia, or pills, composed of calomel or blue mass, compound extract of colocynth, and squill, in equal parts. In the south, however, and, in very paludal localities further north, these medicines must be administered with some reserve. At a comparatively early period, the sulphate of quinine is demanded. At first it should be given in combination with nitrate of potash or muriate of ammonia, in the proportion of five grains of the former to fifteen of the latter; but, as the inflammation declines, opium, in the quantity of half a grain or a grain, may be substituted for the latter, under which treatment the swelling and inflammation will, in general, rapidly abate.

Subacute splenitis is often attended with fever, and the local symptoms are such as to suggest a mild inflammation. Such cases do not require the lancet, but cupping will always be proper. As to the remainder of the treatment, it should be a diminutive of that for the acute form.

SECTION III.

SUPPURATION OF THE SPLEEN.

Parenchymatous splenitis frequently terminates in suppuration. A want of acute sensibility, in the interior structure of the organ, prevents a degree of pain sufficient to alarm either the patient or the physician; and, in many cases, the fever is inconsiderable, and hence the inflammation is left to pursue its course. I once supposed hepatic abscesses commoner than splenic; but more extensive inquiries have shown me the reverse. In my intercourse with physicians, I have collected the following facts:

Doctor Flournoy, of Lexington, Missouri, has met with two cases. The pus was discharged into the bowels. In one, when the patient continued in a recumbent posture for sometime, a swelling in the direction of the left hypochondrium would manifest itself; on pressing which, the flow of pus into the bowels could be heard; and, in a few minutes afterward, there would be a discharge, *per anum*, of that fluid — the tumor having disappeared. The patient seemed every way convalescent, when, from indulging in a large meal of meat; fever and 'colicy pains' supervened, and he died in two days. A hasty post mortem inspection showed, in place of the organ, only a small sack; the aperture from which into the bowel, no doubt the colon, was not found.

The other case was marked by *this* peculiarity. A tumor formed; a discharge of pus took place from the bowels, and the swelling abated; the discharge from the bowels ceased, the swelling rose higher than before, pointed externally, was opened with a lancet, and several ounces of pus escaped, after which recovery took place.

Doctor Twyman, of St. Charles, in the same State, has seen two cases of splenic suppuration. One occurred in a child, three years old, and the discharge was into the bowels. In the other case, the abscess pointed externally, and was opened below the cartilages of the ribs — both recovered. The Doctor has been informed of another in the neighborhood of St. Charles, which terminated in the same manner with the last.

The following case was given me by Doctor Henry, of Springfield, Illinois. Although the subject of it lived in a region where autumnal fever abounds, he was not known to have had that disease. He was a robust man, who had been subject, for several years, to attacks of what was called colic; when, in the winter of 1842–3, immediately after one of them, a painful swelling rose rapidly in the left hypochondrium, for which his physician bled him once, and purged him. The cathartic operated kindly, but afforded no relief. After a while, Doctor H. was called in, and found the left side of the abdomen much enlarged, and both sides tense and tender. A fluctuation was obscurely perceptible on the splenic side, and the attending physician was treating him for ascites. He had a considerable degree of dyspnœa, a dry hacking cough, and would 'hiccup by the hour.' His stomach had been irritable, but was not so at that time. Every morning, he had a slight chill, for which his physician had administered sulphate of quinine. Doctor H. did not advise any active treatment, but rather to wait and watch the progress of the disease. In a month, a sudden and copious discharge of pus and blood, came on from the bowels, with subsidence of the swelling; and a perfect recovery followed.

Doctor Boone, now of Chicago, Illinois, saw, at Hillsboro', in that State, a case of splenic abscess following on intermittent fever, which pointed externally, was opened, and the patient recovered.

Doctor Christian, of Memphis, Tennessee, met with a case, preceded by intermittent fever, in which the organ was greatly enlarged, and an abscess pointed in a mammary form, on the left side of the navel. It opened spontaneously, and discharged, at least, two quarts of pus, after which the patient recovered.

Doctor Shanks, of the same city, saw two cases, in which an accidental blow given to the spleen, when enlarged from intermittent fever, brought on suppurative action, with a discharge of pus by the bowels. Both the patients died; but no post mortem inspection was made.

Doctor Frazier, of the same place, related the following: A river-man, who had been often affected with intermittent fever, suffered an injury of the ankle, which rendered amputation necessary. Two weeks after the operation, he died. On examination of the body, an abscess of the spleen, without any enlargement of the organ, was found. The character of this case is ambiguous, as the pus might have been, and probably was, absorbed from the stump and deposited in the spleen — an example of the cold abscess, of the surgeons.

Of these eleven cases, the discharge of pus in six, was by the bowels; in three externally; in one by both modes; and in one no evacuation took place.

It deserves remark, that none of the abscesses made their way into the stomach, peritoneal cavity, or lungs. It should likewise be noted, that the discharge of pus was not followed by hectic fever; and that all the patients recovered except one, who fell a victim to the indulgence of his appetite during convalescence; and two, who had suffered external injury. Lastly, all the cases occurred north of the thirty-fifth degree, and most of them above the thirty-eighth. Not one case was mentioned to me south of the former parallel of latitude; and hence, we may conclude, that suppuration of the spleen is a northern rather than a southern disease; we are also admonished, by the issue of two cases, that those who have enlargement of the organ, are in danger from mechanical injuries.

The treatment of suppuration of the spleen, after the discharge of pus has commenced, must, of course, be restorative, and consist of nutritious diet (all inordinate indulgencies being avoided); the bark, rendered still more necessary than in ordinary suppurations, from the peculiar diathesis of the patient; elixir vitriol, in combination with that medicine; the blue pill, as an aperient, when one is required; opium, especially at night, and flannel next the skin.

SECTION IV.

ENLARGEMENTS OF THE SPLEEN.

I. By enlargement of the spleen we are not to understand the swelling which accompanies splenitis, which may be inconsiderable, especially when the inflammation is serous. The enlargement, which now occupies us, *may* exist independently of inflammation, and certainly does not arise from it. The same pathological cause, which produces enlargement, may, also, generate inflammation; but, in many cases, it does not; in all, however, it so predisposes to that disease, that slight exciting causes may bring it on. Inflammation is, then, a contingent of enlargement. Now and then it is acute, and may, perhaps, prove fatal; but I have not witnessed such a termination. More commonly, however, it assumes a chronic form, or returns at irregular intervals, in a subacute grade.

II. Enlargements of the spleen are spoken of, by some pathologists, as hypertrophies. But this is a misapplication of the term. The augmentation of size, which can be brought about, in a few days, by a pathological cause, cannot, with propriety, be called an increase of growth. As well might we call anasarca, a hypertrophy of the cellular membrane. The spleen is, undoubtedly, a peculiar variety of erectile tissue; and when it becomes suddenly enlarged, we are bound to regard the material which gives it distension as blood. It may be alledged, however, that it is not blood, but an increase of the peculiar, pulpy matter, which, at all times, fills the areolar structure of the organ; but it seems contrary to analogy, that a pathological condition should augment the product of the healthy function of an organ. The rapid reduction, in bulk, which recent enlargements of the spleen sometimes undergo, is another argument for the theory of simple congestion and stasis. If the contents of the splenic sack be examined, when the organ is in such a state, we, of course, have a mixture of black or stagnant blood, and the peculiar pulp of the organ, with its Malphigian corpuscules. Under this excessive distension and immersion, for sometime, in the same blood, the internal fibrous structure will, of course, lose much of its cohesion; and the whole substance of the organ, when its capsule is penetrated with the finger, be found almost as tender as a coagulum of blood; and this, as we have seen, is the condition of the organ in many who die of autumnal fever.

III. But enlargement very commonly remains long after the fever, which occasioned it, has been cured. On what then does it depend? Doubtless, in some cases, it depends on the coagulation of the blood, whereby its fibrinous portion, in detached or adherent filaments, is mingled with the more fluid portions; and, sometimes, on the infiltration of coagulating lymph, from subacute, parenchymatous inflammation; giving increased density to the organ, and rendering its reduction to the original size an impracticable undertaking. But, in most instances, it would seem there is nothing more than a loss of contractility in the areolar and vascular tissues, by which it continues to receive and contain a large quantity of blood, as in the following —

Case. — Doctor Hurlbert, of Ottawa, Illinois, in the year 1838, was called to see an Irish immigrant, who had been a soldier in the West Indies; while there, he suffered from intermittent fever, and the enlargement of the spleen which followed, had continued for fifteen or twenty years. The organ projected across the abdomen to the right iliac region. When the Doctor arrived, the patient had high fever, with hard pulse, abdominal tenderness, pain in the left hypochondrium, irritable stomach, and some difficulty of breathing—in short, labored under acute splenitis. He was bled five times, blistered, and took freely of calomel and diaphoretics, which subdued the inflammation. During his convalescence, the swelling of his spleen began to abate; and two years afterward, when the Doctor saw him, it was entirely gone. It can scarcely be supposed that this reduction would have taken place, if the organ had been hypertrophied or undurated, for fifteen or twenty years.

IV. I have already referred to two cases of suppuration, in enlarged spleens, from blows on the left hypochondrium. It remains, now, to add, that such violence may occasion a rupture of the organ, and the consequent death of the patient, as appears from the following —

Case. — An Irishman, who had labored on the canal, between Lake Michigan and the Illinois River, for a twelve month, during which he had experienced several attacks of intermittent fever, came to Peoria, Illinois, in a state of emaciation, but with a tumid abdomen. His complexion was of a greenish-yellow tint; while the whites of his eyes showed a bluish tinge. In a quarrel, he received a kick on the region of the spleen, which he survived four days. Doctor Dickinson and Doctor Tucker made a post mortem examination. The intestines were adherent from recent inflammation. The spleen was six or seven times its usual size; some parts of it were in a state of induration, and of a greenish-yellow color; others were softer and darker. It was ruptured, and a quantity of blood had escaped into the peritoneal cavity.

But the rupture may be spontaneous, as appears from the following —

Case. — A patient of Doctor Cross, in the same town, had intermittent fever for eight or ten days, from which he recovered. About a month afterward, he was attacked with ague, of which he had several relapses. On a certain morning, while walking about, he was attacked with a chill, followed by fever. He took a cathartic, and on rising, during the hot stage, he fell down and expired. Twenty hours after death, his body was examined. The spleen presented a large circular and ragged aperture; and was so tender that it could not bear its own weight. About a gallon of blood, taking that which had already escaped into the peritoneum, with what was forced by compression, made the quantity which the organ had contained.

V. In its early stages, enlargement of the spleen may be detected by dullness of sound, on percussion, over the false ribs of the left side, the respiratory murmur of that region being unaltered. But, that this sign may lead to a false diagnosis, I was lately taught by the subjoined —

Case. — I was called into consultation by Doctor Dodge, of this city, on a patient who labored under cerebral inflammation, of which he died. In attempting, by percussion and auscultation, to ascertain whether his disease might not be complicated with pneumonia, we found a manifest dullness over the left hypochondriac region; but the respiratory murmur was entirely normal. We, of course, concluded that, from an attack of autumnal fever at some former period, he had an enlargement of the spleen, though not great enough to project below the ribs; but to our surprise, on examining the body after death, we found the left lobe of the liver so hypertrophied, that it was jammed against the spleen, which had its natural size.

After the tumor has advanced below the cartilages of the ribs, it cannot be confounded with any other swelling, except that attendant on suppuration of the kidneys, from which it may be distinguished by the previous history.

The subject of enlarged spleen is, generally, more or less emaciated in his limbs, while his abdomen is tumid. His complexion is wan; yellowish, but less so than in affections of the liver; indistinctly greenish, or chlorotic, dirty leuco-phlegmatic; or, finally, that of cancerous cachexia. The whites of the eyes have not the sallowness produced by liver disease. This change of complexion, deserves to be taken into account in our investigations into the functions of the spleen. Is it probable that the organ exerts any influence on the hematosis of the blood? That the blood is in a pathological condition, cannot, I think, be doubted; not only from the altered complexion of the patient, but from the hæmorrhages from the stomach and bowels, to which he is liable. I knew a gentleman with enlarged spleen, who had two copious hæmorrhages of this kind; and a number of our physicians have witnessed the same thing. As illustrating this assertion, and showing, at the same time, two other interesting facts, I will cite a case given me by Doctor Wallace, of Akron, Ohio.

Case. — A man experienced an attack of remittent fever, with relapses, in an intermittent form, and was severely salivated. There followed on this treatment, so great a susceptibility to the action of all mercurial preparations, that for years afterward, he could detect the smallest quantity, administered to him, by the constitutional irritation, morbid vigilance, and diarrhœa, that would inevitably follow. When exposed to a cold and damp atmosphere, his spleen would suddenly swell, so as to bulge out below his ribs; and in the course of the following night, under the influence of opium, and diaphoretics, it would recede. He was never without tenderness in the splenic region; but had no dropsy. He used iodine with some benefit, but, while his health seemed to be gradually improving, he died, suddenly, of hæmorrhage from the stomach and bowels.

Of the influence of enlarged spleen, in favoring relapses in intermittent fever, I have already spoken. Some patients have observed, that active exercise was followed by a return of the Fever. The connection between this affection of the spleen, and dropsy, will be considered, in another section. In many cases, the appetite of the patient, and his digestion, are very tolerable; and he regards his 'ague-cake,' as a mere inconvenience. In some instances, however, it becomes a burden, for it may extend into the right iliac region, and rest upon the brim of the pelvis. In general, the enlarged spleen does not leave its position; but, a short time since, Doctor Moffit, one of the house physicians of the Commercial Hospital, in this city, called my attention to a patient, who some years before had suffered from intermittent fever, in whose abdomen there was a hard, spleniform tumor, three or four times the size of the spleen, which could be moved to any part of the abdomen, though it inclined to the left side; and could be nothing else, I think, but that organ in a state of dislocation.

VI. Treatment.—When the symptoms of splenitis are present, the appropriate antiphlogistic treatment, must be first employed; under which the enlargement sometimes rapidly diminishes. But the majority of cases do not thus yield; and then the practice becomes in a great degree empirical, consisting of various therapeutic agents, which we must consider, *seriatim.*

1. An occasional *emetic* is beneficial. It agitates the affected organ, and thus promotes the circulation of its stagnant blood; increases the activity of the absorbent vessels; determines to the surface of the body; and prepares

the stomach for the reception of other medicines. But the loss of density and strength, in the capsule and fibrous texture of the spleen, is sometimes so great, that in vomiting, a rupture might occur; and, therefore, emetics should not be ordered, without care and circumspection.

2. *Cathartics* are not liable to that objection; and, those which act as hydrogogues, often prove beneficial. Care must be taken not to reproduce the Fever, by continuing their action too long. One of the best is the compound powder of jalap with the bark. Another is a pill composed of one grain of blue mass, one of aloes, two of rhubarb, and a fourth of a grain of elaterium. Free purging may be effected with two or three of these pills; and a single one will operate as an aperient. When the liver is torpid, and the discharges are not colored with bile, the elaterium should be omitted, and the quantity of blue mass doubled.

3. *Diuretics* are frequently prescribed in this affection. They were probably, at first, suggested by the dropsy which is often present. I am not certain as to their effects in my own practice, but have thought them beneficial. The following formula is as good as any other:

℞. Pulverized squill, - - - - - - gr. xxiv.
Nitrate of potash, - - - - - - - ʒii.

Mix intimately, and divide into twelve papers: One to be taken three times a day. When inflammation is present, this refrigerant diuretic will be peculiarly proper. In an opposite diathesis, or when the tendency to relapse is great, two grains of the sulphate of quinine should be added to the powder.

4. The *bark*, combined with an equal quantity of cream of tartar, has often done good. Should this compound purge too much, the proportion of the latter must be diminished.

But the sulphate of quinine has attained a higher reputation than the bark. It is peculiarly demanded in recent cases, while the original morbid diathesis still lingers in the system. When given in the declining stage of splenitis its effects on the enlargement, are, perhaps, more favorable than in any other condition. And this leads me to say, that when no inflammation is present, an occasional bloodletting, if the powers of the system should not be greatly reduced, will much increase the efficacy of the bark, quinine, and other bitters, stimulants, and alterants. Many physicians, who practice where malignant intermittents prevail, speak in high terms of quinine, in the splenic enlargements, which are so rapidly generated by that form of fever; but, I have not met with any, who had witnessed the instantaneous effects which Piorry declares he has seen in the hospitals of Paris. When inflammation still lingers in the organ, the union of nitrate of potash with the quinine, is highly beneficial. Ten grains of the former, with five grains of the latter, may be given three or four times in the twenty-four hours. On the other hand, if the excitement be low, it will be proper to substitute for the nitre, five grains of Dover's powder.

5. *Iodine*, from its promoting the absorption of goitrous tumors, has been extensively employed for enlargements of the spleen; and was expected to

act on the absorbent system. It has, undoubtedly, effected the object for which it was administered; but not so constantly as to meet the anticipations under which it was at first prescribed. An extemporaneous formula, consisting of iodine or its tincture, administered in a solution of the hydriodate of potash, may be readily devised; or the latter may be given alone, in quantities varying from half a drachm to two drachms in the day and night.

In the hands of some of our physicians, bromine has proved useful; but I cannot speak of it from experience.

6. Referring to the impoverished or spanæmic condition of the blood, *chalybeates* seem indicated. I have seen good effects from the pro-carbonate of iron, in combination with the bi-tartrate of potash; but the best preparation, when properly made and preserved, is the iodide of iron. It may be presumed that the ferro-cyanate of quinine would be efficacious, in cases demanding a chalybeate, but I do not know that it has been employed.

7. *Counter irritation*, with blisters or antimonial ointment, is a common remedy. The former are to be preferred. To be of service, the plaster should be large.

8. Throughout the whole treatment, the patient should be supported by nutritious diet, and have the excitement and perspiratory function of the skin maintained by stimulating baths, frictions, and the use of flannel.

9. In many instances it is impossible to reduce the enlargement, while the patient continues in the locality where it originated; and it has been known to disappear, without remedies, under a change of place. Thus, Doctor Echols, of Selma, Alabama, went to Lexington for the prosecution of his studies, while laboring under an enlarged spleen; and returned, in eighteen months, free from the disease, although he had discontinued all medicines.

VII. Actual Practice of many of our Physicians. — I will now mention the modes of practice pursued by a number of physicians, beginning with the northern:

Doctor Conant, of Maumee, Ohio, treats subacute inflammatory cases with oil of turpentine, externally and internally. Professor Brainard, of Chicago, Illinois, uses the blue mass, sulphate of quinine, and extract of taraxicum, with blisters. Doctor Henry, of Springfield, in the same State, after trying iodine ointment and mild mercurials, with some success, was led to employ the sulphate of quinine and the blue mass combined; from which he obtained much greater benefits. Doctor Frye, of Peoria, in the State just mentioned, uses sulphate of quinine and sulphate of iron combined, keeping the bowels open with jalap or the extract of taraxicum. Has seen the hydrobromate of potash cure two cases, and do good in a third. Doctor Howland, of Ottawa, in that State, sometimes bleeds once; but relies upon the external use of iodine, and the internal administration of extract of conium maculatum, sulphate of iron, and aloes, combined, and given in pills. Doctor Thomas, of Boonville, Missouri, has used muriate of ammonia with advantage. Doctor Hutchinson, of the same place, has cured the disease with blue pill and blisters. Doctor Flournoy, of Lexington, often bleeds in the beginning, then gives the muriate of ammonia, blue pill, and tartar emetic, combined, employing external irritants at the same time. Doctor Digges, of the same town, uses iodine and cutaneous irritation. He has tried the muriate of ammonia only in old cases, when it failed. Doctor Long, of Marshall, in that State, has found the sulphate of quinine beneficial. Doctor Price, of Arrow Rock, uses external irritation, and administers the hydriodate of potash, with aperients, internally. Doctor Christian, of Memphis, has used small doses of calomel or blue pill, with tartar emetic, and muriate of ammonia, followed by the bark; but has often found a change of locality indispensable to recovery. Doctors Shanks and Frazier, of the same city, have employed scarification and cupping, dry cupping, blistering, and the deuto-ioduret of mercury, externally, with bitters and stimulating aperients, internally.

Doctor S. B. Malone, of Columbus, Mississippi, blisters, applies a plaster of cicuta, and administers calomel and the sulphate of quinine. Doctor Searcy, of Tuscaloosa, Alabama, has found the following compound useful:

℞. Sulphate of quinine, - - - - } each ʒi.
Castile soap, - - - - - - }
Aloes, - - - - - - - - }
Rhubarb, - - - - - - - } each ʒss.
Blue mass, - - - - - - - }

Mix, and make into pills of the common size — one to be given three times a day. Doctor Guild, of the same town, bleeds, purges, and then administers quinine. Doctor Haywood, also of the same town, has found the disease to disappear spontaneously; but sometimes uses calomel and tartar emetic in small doses. Doctors Dancy, Parish, and Davis, of Greensboro', in the same State, have observed the spontaneous disappearance of the disease; but, occasionally, prescribe blisters or tartar emetic ointment, and small doses of calomel. Doctor Echols, of Selma, treats it with cathartics and external liniments. Doctor Fearn, of Mobile, has used, successfully, the blue mass and rhubarb at night, with carbonate of potash and powdered mustard as diuretics, and the sulphate of quinine, with infusion of gentian, as a tonic.

VIII. Concluding Remarks. — I find, on examining my notes, that in many instances, the treatment of enlargement of the spleen, was overlooked, in my conversations with medical gentlemen; but quotations enough have been made, to show the state of medical practice among us, in that affection. On the whole, I am disposed to believe it more inflammatory and obstinate in the north, than the south; as well as more frequent, in proportion to the number of cases of intermittent fever. In the warmer latitudes, the enlargement seems to partake more of the character of simple congestion, than in the colder climates.

It has sometimes been supposed, that a premature use of the bark contributed to the production of enlarged spleen. If this ever happened, it was because the lancet had not been adequately employed before resorting to that medicine; which, from its tonic and stimulating qualities, may, at the same time that it arrests the paroxysms of fever, contribute to disorder the viscera.

Such an objection will not lie against the sulphate of quinine; and the sooner the Fever is checked, the less is the danger of enlarged spleen; as it is the repetition of the paroxysms, more than anything else, which produces that organic derangement. Nevertheless, venesection, in the higher latitudes, is of great value, as a preparative of the system for the quinine; and it is the omission of the lancet, which in many cases permits a result, that throws discredit on the quinine.

SECTION V.

DISEASES OF THE LIVER FROM AUTUMNAL FEVER.

I. There is much in the symptomatology, and pathological anatomy of our autumnal fever, to raise and perpetuate, in our minds, the idea of a deep implication of the liver; much to justify the epithet 'bilious,' so generally applied to them; which, indeed, would be a very convenient and appropriate term, if it could be so used, as not to suggest the idea of their originating, from some primary affection of the liver. All this implies, that the biliary function is, in general, greatly disturbed in these fevers; which, we have already shown, both by the phenomena during life, and the appearances after death, to be the case. The proper treatment of the morbid conditions of the liver during the Fever, has been already pointed out; and we come, now, to inquire into its condition after the Fever has been arrested. In doing this, the first fact which meets us is, that in many cases, the functions of the organ are natural and healthy, from the termination of the Fever; the next, that when they are morbid, the liver appears in some cases to be free from inflammation, in others to be inflamed. We must study these conditions separately.

II. Mere Functional Lesions. — 1. Torpor, or inactivity of the organ, in its secretory or excretory function, appears, sometimes, to constitute the only morbid condition. I am disposed to believe, that the liver is not, like the kidneys or the lungs, an organ which secretes continuously, but that its action is essentially intermittent. Its relations are with the stomach and duodenum, whose functions are periodical; and the whole may be presumed to work, under the same law of intermittence. The universal habit of taking food *at intervals*, and the certainty with which digestion is impaired, by the introduction of new aliment, while that previously taken, is undergoing conversion into chyme, demonstrate, that hunger and the functions of digestion, are essentially periodical. That, while they may be modified by habit, they are the cause and not the effect of habit. The reason of this, lies quite on the surface. If food were taken continuously, much of it would necessarily pass the pylorus undigested; and not having experienced the action of the stomach, could not be converted into chyle, and would be lost to the nourishment of the system. The natural periodicity of the functions of the stomach being established; a corresponding periodicity, must be admitted in the functions of the duodenum. The chyme being prepared, the pylorus expands, and the stomach, changing its mode of muscular movement, from a gestatory to a peristaltic or expulsive, pushes the alimentary mass into the supplemental organ; there to receive an impregnation of bile and pancreatic juice; after which, the compound is to be transmitted to the small intestines, for absorption into the system. Now, it would be a physiological absurdity, for the liver and pancreas, to pour out continuous currents of secreted fluid, when the ends for which they are formed, can only be accomplished at intervals. I conclude, then, that those organs, when the individual is in health, are stimulated into activity, by the impress of food in the stomach, the excited state of which, invites into the cœliac artery, more blood than before; whereby more is sent through the liver, by the hepatic artery, and especially by the vena porta; and, thus, it is not only roused into action by its nervous association with the stomach, but by the increased supply of blood. The secretion of bile and pancreatic juice goes on with activity, under such circumstances; the excretory ducts become filled; and, by the time the chyme begins to pass the pylorus, the currents of secreted fluid, are pouring into the duodenum, to mingle with it — secretion, then, giving place to excretion, to be revived on the next call of the stomach. If these physiological speculations be correct, it follows, that while the liver performs a continuous function of circulation, in transmitting the blood of the vena porta, it executes a periodical function, of secretion and excretion.

Now, an organ whose function is periodical, is much more likely to fall into torpor or inaction, than one whose function is incessant. Hence the frequency of torpidity, or suspended secretion, in the liver, and its continuance, in so many instances, after attacks of autumnal fever. In this condition, the elements of the bile, which are developed in the blood, are not collected and combined in that organ; and one of them, the coloring matter, manifests itself in the complexion, the urine, and the serum of the blood. In this manner, a variety of jaundice, more or less intense, may arise. But when the secretion of bile is not suspended, the *excretion* may be. The biliary ducts may not act with energy; or duodenal inflammation or irritation, during the Fever, may have extended to the common gall duct, and caused a thickening of its mucous membrane, or a spasmodic constriction; which, remaining, may interfere with the excretion of the bile. In these pathological conditions, the sallowness may be even deeper than in the other; and in all, the stomach, from its sympathy with the liver, and the bowels from the same cause, and also from the absence of their natural stimulus, the bile, soon show a variety of functional disturbances, such as anorexia, flatulence, acidity, constipation, or diarrhœa. As long as these conditions of the liver continue, the convalescence of the patient will be slow and unsatisfactory; his muscles of locomotion will be weak; his heart feeble and irritated; his nervous system morbidly sensitive, and his spirits gloomy. All this, I suppose, may exist without the slightest inflammatory affection of the organ; but it constitutes a good predisposition; and, if allowed to continue, vicissitudes of temperature, or some other cause, may, at length, excite inflammation. Let us now direct our attention to the removal of these functional disorders.

III. The Remedies.—Before prescribing for the pathological conditions, the physician should, by his knowledge of diagnosis, ascertain that inflammation does not exist, when he may pursue the following method:

1. An active emetic is generally of signal service. Nothing arouses the liver to renewed secretory action, or emulges its ducts, more successfully. One of the best is an infusion of the root of the sanguinaria candensis with ipecac. Tartarized antimony is too sedative; and, if it be used, should be dissolved in some stimulating draught, as a tea of valerian root; an opiate to be given after the operation.

2. An active cathartic should next be administered. If the patient should labor under diarrhœa, a large dose of calomel and rhubarb, followed by an opiate at night, will be proper. If costive, a portion of calomel at night, with infusion of senna the next morning, or a dose of pills, composed of equal parts of calomel, gamboge, and aloes, should be given; and, after the operation, an anodyne.

3. The patient may now be put upon the use, every night, of two or more of the following pills:

℞. Blue mass, - - - - - - - - ⎫
Aloes, - - - - - - - - - - - ⎬ each ʒss.
Ipecac, - - - - - - - - - - ⎭
Extract of taraxacum, - - - - - ʒiss.

Mix, and make into thirty-two pills.

4. In the day, as much tincture of rhubarb with gentian, as may be necessary to secure, with the pills, two or three alvine evacuations, should be administered; or the pills being sufficient to keep up the action of the bowels; a cold infusion (made by displacement) of the bark of the wild cherry tree (*Prunus Virginiana*), may be substituted for the tincture, which will be especially required when there is stricture of the common gall duct—the prussic acid of the infusion, being well fitted to relieve that condition; while it stimulates the patient into greater cheerfulness.

5. Antacids will, in most cases, be required. The subcarbonated alkalies, answer very well in ordinary cases; but, if the bowels should be obstinately torpid, magnesia will be better; or, on the other hand, if diarrhœa be present, lime-water and boiled milk should be preferred.

6. The region of the liver should be sponged, and the feet immersed, in a hot nitro-muriatic solution, and flannel should be worn next the skin.

7. The diet of the patient ought to be nutritious, savory, and stimulating, but moderate in quantity.

8. He should be exhorted to take as much exercise as possible, on horseback, or on foot, in the open air.

9. Throughout the whole treatment, his nervous system will demand gentle narcotics and stimulants, especially at night, of which more will be said under the next head.

By these means, the uninflammatory hepatic torpor, following our autumnal fever may, in general, be soon removed. Let us now turn our attention to the inflammatory condition of the liver.

IV. Subacute Hepatitis. — The acute inflammation to which the liver is liable, during the Fever, may remain in a subacute form, after that disease has been arrested; or the organ being, at the close of the Fever, in a state of torpor or engorgement, inflammation, under the influence of exciting causes, may supervene. On the relations between subacute hepatitis and the Fever, of which it is a consequence, the following remarks may be made:

1. While, as we have seen, splenitis oftener follows intermittent than remittent fever, hepatitis is more frequently the effect of the latter than the former. It would be erroneous to say, that either is confined to a particular form of the Fever; but that each has a closer connection with one than the other is, I think, certain. I cannot explain the more frequent occurrence of hepatitis than splenitis, in remittent fever, except it be, that a gastro-enteritis is oftener present in the former than the latter, and by continuity of mucous membrane, or sympathy, excites hepatitis.

2. Of the relative frequency of these two affections, as consequences of autumnal fever, I cannot speak with statistical or numerical accuracy, but believe that the spleen suffers oftener than the liver. Slight degrees of inflammation may pass undetected in the former organ; but, when seated in the latter, they manifest themselves in an obvious manner. Thus, it seems probable, from the number of known cases of splenitis, that if all were discovered, the catalogue would much exceed that of hepatitis, from the causes we are now considering.

3. Of the relative prevalence of hepatitis, from the Fever, in the north and the south, I cannot speak positively; but inquiry has satisfied me, that there is quite as much of it in the former as in the latter, in proportion to the number of fever cases.

4. Hepatitis, I think, is more apt to run into suppuration, in the southern than in the northern portions of the Valley. The number of hepatic suppurations, of which I have collected an account, is less than the number of splenic abscesses. A large majority of them were south of Memphis; the reverse of what is true in regard to abscesses of the spleen. Of the cases, the mode of termination of which I have ascertained, five, occurring in the practice of Doctor Drish, of Tuscaloosa, Alabama, discharged themselves through the lungs; one, a patient of Doctor Shanks, of Memphis, opened externally; and one, mentioned to me by Doctor Vivian, of Dover, Missouri, took the direction of the bowels. Doctor Fearn, of Mobile, has had several cases, the termination of which I did not record.

5. In estimating the influence of autumnal fever in producing hepatitis, we must not forget the effects of alcoholic intemperance, in exciting or predisposing to that affection; and thus causing it to occur more frequently than it would from the Fever alone.

6. When at Memphis, Doctor Shanks took me to see a river-woman, who, after an attack of intermittent fever, had, at the same time, an enlarged spleen, and a suppurating liver which pointed externally.

7. If hepatic abscesses, as appears probable, are more common, in proportion to the number of cases of hepatitis, in the south than in the north, it follows that the inflammation is oftener parenchymatous in the former — membranous in the latter; and this may explain the fact, that bilious appearances are rather more conspicuous to the south than the north, while the number of cases of hepatitis is not greater.

8. There are few inflammations more apt to recur than hepatitis. I know a lady in whom the disease followed autumnal fever, while she was still a child, that relapsed, at various times, for the next thirty years; several of the attacks being prolonged and violent.

II. The symptoms of subacute or chronic hepatitis, are constipation or diarrhœa; a suspended, depraved, or increased secretion of bile; acidity and irritability of stomach; variable appetite; in general, a foul and yellowish tongue; more or less jaundice of the skin and eyes, with yellowness of the urine; tenderness, and sometimes pain in the epigastric and right hypochondriac regions; aching about the right shoulder, sometimes descending into the arm; inconvenience in lying on the left side; a hacking cough, without expectoration; a dry, harsh, and insensible skin, with coldness of the feet; occasional flushes of fever, according to the degree of inflammation; almost constant frequency of the pulse, with fits of palpitation of the heart; reduced activity of mind, whimsicality, despondency, irresolution, and fear of death. In addition to the direct sympathy of various parts of the body with the liver, they sympathize with the stomach, which is dyspeptic; with the bowels, from which the liver withholds a due supply of bile, or irritates, with that which is unhealthy; but, above all, the whole nervous system, and, indeed, all the tissues of the body, are irritated by the bile, or its elements, which float with the circulating currents, and act on the exquisitely, susceptible, interior membrane of the arteries.

III. 1. In the treatment of the hepatitis following on autumnal fever, a copious bloodletting, in the higher latitudes, is, in some cases, indispensable; but there are very few patients that will bear its repetition; and the greater number do not demand the lancet. The depressing influence of biliary matter, mingled with the blood, seems to be the reason why copious venesection is not supported in this inflammation; but we must ascribe a part of the intolerance of this remedy, to the paroxysmal character of the Fever, which generated the inflammation. When general bleeding seems inadvisable, cupping may be employed with advantage.

2. The administration of small doses of calomel or the blue mass — but I regard the former as preferable — should be continued to the extent of ten or twenty grains a day, until the mouth is slightly affected. If much fever be present, and the stomach irritable, nitrate of potash may be advantageously combined with the calomel; but when that organ is not specially involved, and the phlogistic action is considerable, minute doses of tartarized antimony or ipecac will prove beneficial.

3. An occasional emetic or cathartic does good, by emulging the gall ducts

— the inflammation being of a low grade — and, at all times, the latter will be proper, to keep up the peristalsic action of the bowels.

4. In obstinate cases, nitric acid internally may be tried; and, in every stage and grade of the disease, the nitro-muriatic lotion to the right hypochondriac region, and the feet, will be beneficial.

5. The extract of taraxacum often does good in this disease; but to produce effect, it should be administered in larger quantities than are commonly given. Its powers are feeble; and less than two drachms, every twenty-four hours, will not be likely to accomplish anything.

6. When the disease continues till the succeeding summer, and is accompanied by constipation of the bowels, sulphur-waters, drank for a few weeks, are often exceedingly beneficial. But, to prove so, the keen appetite which they produce, must not be indulged; and, by the use of an opiate at bed time, the sulphur should, if possible, be determined to the skin.

7. In every stage of the disease, the morbid sensibility and irritability of the system, must be paliated, with gentle narcotics, and anti-spasmodics; which, as far as practicable, should be so combined with diaphoretics, as to act upon the skin. To this end, it is advantageous to combine Dover's powder, with the evening dose of calomel; but the constitutional irritation often requires the administration of gentle narcotics, and stimulants in the day, when a pill of four grains of assafœtida, and a fourth of a grain of opium, may be administered, at such intervals as seem necessary. Or, in its stead, the following formula may be used:

℞. Sulphate of morphine, - - - - - - - gr.ii.
Sulphuric ether, - - - - - - - - ʒij.
Simple syrup, - - - - - - - - - ℥ii. Mix.

A teaspoonful, diluted with cold water, to be taken at discretion.

As all medicines of this class, soon lose their effects; and many cases of subacute hepatitis, continue for a long time; a change of the narcotico-antispasmodic, often becomes necessary; and therefore, I subjoin the following:

℞. Tincture of valerian, - - - - - - - ℥ii.
Ammoniated alcohol, - - - - - - - ʒii.
Tincture of opium, - - - - - - - - ʒi. Mix.

A teaspoonful to be occasionally administered.

When we look at the value of the sulphate of quinine, in chronic splenitis, we may suppose that, it must be serviceable in chronic hepatitis from autumnal fever, and as it coincides, in action, with the medicines we are now considering, it is proper to employ it. Combined with Dover's powder, in the proportion of five grains of one to ten of the other, it may be given at night; or it may be administered, now and then, throughout the twenty-four hours, according to the following formula:

℞. Sulphate of quinine, - - - - - - - - ℈i.
" morphine, - - - - - - gr.i.
Aromatic sulphuric acid, - - - - - - gt.x.
Sulphuric ether, - - - - - - - - - - ʒi.
Simple syrup, - - - - - - - - - - - ℥i. Mix.

A teaspoonful to be given, as occasion may require.

8. In many instances, a change of climate becomes indispensable. It must always be made from a warmer to a colder latitude; choosing, at the same time, a locality but little infested with autumnal fever.

9. I do not give a separate consideration to the diarrhœa, which in some cases follows on autumnal fever, as it is, generally, symptomatic of liver disease, and ceases when its pathological cause is removed.

SECTION VI.

DROPSY.

I. History. — Dropsy is another consequence of autumnal fever. In slight cases, the serous infiltration is limited to the lower extremities; but in the graver, extends to the whole sub-cutaneous cellular tissue, giving universal anasarca. Ascites is less common; and, never occurs, I believe, without cellular infiltration of the legs and feet. Hydrothorax from this cause, is exceedingly rare, and hydropericardium, still rarer.

Dropsy seldom follows on remittent fever, except it terminate in the intermittent form. When intermittents are cured at an early period, dropsy seldom appears. Chronic cases are commonly its pathological cause. Sometimes, when the anasarca commences, the paroxysms of fever cease to recur; and, after the lapse of a little time, the effusion ceases, that which had accumulated is absorbed, and the patient is restored. In other cases, both the paroxysms and the infiltration, keep on, until the limbs swell to a great size, and the ascites assumes a formidable character. In such cases, the Fever has been peculiarly obstinate, and of long duration; or the constitution has been previously broken down by other diseases, or by intemperance. A high grade of the lymphatic temperament may, however, lead to the same result. Under these sinister circumstances, the disease may prove intractable; and hydrothorax, or even hydropericardium, may, at last, supervene, and prove fatal. Dropsy from autumnal fever, prevails as extensively as the Fever itself; but whether it occurs more frequently to the north or to the south, I am unable to say.

II. Pathology. — A difference of opinion prevails as to the immediate cause of this serous accumulation.

1. One theory is, that the absorbent system is left in a torpid condition by the Fever, in consequence of which the serum, which naturally bedews the cellular tissue, and the peritoneal sack, becomes accumulated; and the

practice founded on this assumption is generally successful; a fact which supports, though it may not establish, the hypothesis.

2. Another theory, refers it to increased secretion. This has been applied to ascites, oftener than to anasarca; the peritoneum having been left, it was said, in a state of subacute inflammation. Such a condition of that membrane may undoubtedly exist after the Fever, and produce ascites; but we have no evidence of the fact; or that any degree of inflammatory action, prevails in the cellular tissue of the extremities. By experiments on the urine, I have found that, sometimes it is albuminous; oftener is not. But if that condition should be present, and as Doctor Blackall believes, indicate inflammation, it does not follow, that it would be in the peritoneum, seeing that both the liver and the spleen are more probable seats.

3. The popular opinion, both in and out of the profession, is, that these dropsies are occasioned by diseases of the spleen; which operate to produce effusion, in two modes; *a.* By the increased secretion from the inflamed surface, generating ascites; *b.* By the compression of the vena portæ, when the organ is enlarged, obstructing the return of blood from the abdominal viscera, and thus occasioning effusion into the peritoneal cavity; while by compression of the ascending vena cava, it determines a state of venous congestion in the lower extremities, and a consequent increase of serous effusion. That a subacute inflammation of the serous covering of the spleen, may cause increased secretion, is undeniable; but in many cases, the extent of that surface is so entirely disproportionate to the amount of dropsic effusion into the cavity of the peritoneum, as greatly to invalidate this hypothesis; which, moreover, will not in any degree explain the production of anasarca. But may not compression of the vena portæ be adopted as the pathological cause of ascites? The answer must be in the negative; for, in the first place, many cases of ascites occur when the spleen is not so enlarged as to reach to the linea alba; and in the second place, it is almost impossible that *any* enlargement, however great, or in whatever direction, should exercise a compressing power over that vein. Still less can it be exercised upon the hepatic veins. But in reference to anasarca, the opinion is held, that the enlarged organ, exerts itself on the ascending cava. In this case, however, the ascites is left unexplained. Nevertheless, as the two forms of dropsy *may* depend on different pathological causes, it is proper that splenic enlargement, as a cause of anasarca, should be more carefully considered.

I assume, then, that this enlargement is not a mechanical cause of anasarca, and rest the assumption on the following facts:

a. It seems nearly impossible, that enlargement of the spleen should compress the ascending cava; which not only lies to the right side of the vertebra, but is protected by the aorta, the diameter of which, however, it must be admitted, is not equal to that of the cava. And, as the organ advances across the abdomen, its convex surface continues in contact with the anterior walls, and the stomach and bowels are consequently behind, and interposed between, it and the great vein.

b. Many cases of anasarca follow intermittent fever, when the spleen is so little enlarged, as not to reach the median line of the abdomen, nor, even, project beyond the cartilages of the ribs; and when, of course, its mechanical action on the vein is an impossibility.

c. It is a fact of general notoriety, that many persons have their spleens enlarged to great dimensions, even for years, without experiencing anasarca.

d. It is equally true, that when both affections exist, the anasarca may be removed, and the enlarged spleen still remain.

e. We frequently see a considerable degree of œdema of the face, and other portions of the body, coëxisting with the anasarca of the lower extremities, and this too when the patient has not just risen from a recumbent posture, favoring the diffusion of the serum throughout the cellular system generally, but after he has been on his feet throughout the day; showing that the effusion had taken place in the upper parts of the body.

From these facts we may conclude that although enlarged spleen and dropsy, often coëxist, after intermittent fever, the former is not a *mechanical* cause of the latter. And, yet, it seems probable, that enlargements of the spleen do, but in a different manner, favor the production of dropsy. The blood which sojourns in the organ, may, perhaps, undergo changes, which contribute to a vitiation of the whole mass. We must, I think, admit such changes, though we are unable to show their exact nature. We know that in many cases, of rupture of the organ, or of cutting into it in post mortem inspections, the blood which escapes is unusually black and will not spontaneously coagulate. Professor Gross,* has cited a great number of authorities, for the fact, that in fevers, both the peculiar pulp, and the blood, of enlarged spleens, may assume a dark, dirty hue, a black-currant-jelly-like appearance, or the aspect of tar. Now, this blood, if the patient should not die, must of necessity, sooner or later, make its way through the vena portæ, to the general circulation; and thus, if a morbid state of that fluid can be a cause of dropsy, it may be, that enlargement of the spleen, contributes to the production of that disease.

4. The diseases of the liver, studied in the last section, have been regarded as the cause of dropsy. Let us look at the facts in support of this opinion:

a. Diseases of the liver, from intemperance, produce permanent jaundice, and, finally, all the different forms of dropsy; and why may not hepatic diseases, from autumnal fever, originate the same effusions?

b. But it may be said, that remittent fever disorders the liver more than intermittent, while dropsy oftener follows the latter than the former. This, however, may be for the reason, that intermittents so often follow remittents. The mischief to the organ, may have been done in the early stage of the fever: its consequences may show themselves after the fever has ceased, or changed to an intermittent. Original intermittents, however, do themselves

* Pathological Anatomy: Article Spleen.

produce lesions of that organ, of which every physician, in the Valley, must have seen examples.

c. We can perceive how organic disorders of the liver may produce dropsy: *First.* An obstructed circulation through the organ, necessarily leads to a state of venous congestion, in all the portal viscera; which may be the proximate cause of increased serous secretion into the peritoneal sack, and the production of ascites. *Second.* When tumefied, the organ, from lyingnear to and on the same side of the vertebral column with the vena cava, may compress it, and thus generate anasarca.

d. Beside the function of transmitting the blood from the other abdominal organs, the liver is charged with separating from it the elements of the bile, which, failing adequately to do, they accumulate in that fluid. It appears, moreover, that in autumnal fever, there is an extraordinary development of biliary elements; and that a copious secretion and excretion of bile is, in general, a condition of perfect recovery. Here, then, we have an abundant source of impurity of the blood; and to this pathological state, we may, perhaps, in part, ascribe the hydropic effusion.

5. It is well known, that in protracted intermittent fever, the sweats, which follow the occasional paroxysms, are generally offensive. Even while I am writing this article, a student, laboring under a relapsing intermittent, with subacute inflammation of the spleen, but without liver disease or dropsy, assures me, that the perspiration which follows every return of his chill and fever, is sour and disgusting in its odor; a sufficient evidence of a pathological state of the blood.

6. The state of the urinary secretion, in autumnal fever, has not been well studied. We know, however, that the quantity of urine is often deficient; and that, in chronic cases, it frequently throws down sediments; another evidence that the blood is unhealthy.

7. To these sources of impurity we may, perhaps, add one more — the constitutional morbid action of the solids. Whatever difficulty may now exist, or may forever exist, in comprehending the reciprocal actions and reactions of the blood and the containing solid tissues, no accurate observer can fail to notice many proofs of their reality. The blood and the solids are, in fact, so united anatomically and physiologically — placed in such relation to each other — that, *a priori*, it seems quite impossible for one to be in a morbid condition, without affecting the other; and, hence, in the course of a protracted and relapsing intermittent fever, the blood may become impoverished in its red corpuscles or fibrin, or be otherwise deteriorated.

To the morbid condition of that fluid, generated in so many different ways, we should, no doubt, ascribe the leucophlegmatic, wan, leaden, or sallow appearance of those who have long had ague and fever; and we may, perhaps, refer to the same pathological cause, the copious hæmorrhages from the stomach and bowels; which, as we have already seen, sometimes follow that disease, and which are, commonly, but not intelligibly, ascribed to enlarged spleen. Of the tendency to hæmorrhage, created by a deteriorated state of the blood, we have instructive examples in scurvy.

Let us now proceed to inquire whether we can deduce the dropsy consequent on autumnal fever, in whole or in part, from this sanguineous vitiation.

8. In proceeding to do this, we must exclude from the inquiry, *First.* The cases of ascites, which arise from subacute inflammation of the peritoneum. *Second.* Those which result from obstructed transmission of blood, through the hepatic ramifications of the vena portæ; and *Third.* Those anasarcas, if any, which are caused by the pressure of an enlarged liver on the ascending vena cava. After excluding all the cases which result from these pathological causes, I suppose a much larger number remain unaccounted for, and to them we must now give attention.

The pathological data, which lie before us, are the following: *First.* A relaxed and inactive state of the solids generally; *Second.* An impaired activity of the organs of excretion, especially of the skin, liver, and kidneys. *Third.* A deteriorated state of the blood.

Now, it is a physiological law, that if matters foreign to the constitution of the blood, find their way into it, by absorption, either external or interstitial; or are developed in it by disorder of the solids; or retained in it by defect of excernent action, they must either be decomposed and become a part of that fluid; or be eliminated through some of the emunctories of the system, or into its cavities. In the case of poisons injected into the blood vessels, some take one direction, others another. Iodine and nitrate of potash seek the kidneys —emetin and phosphorus the lungs—tartar emetic the mucous membrane of the bowels. But in the case of dead organic matter, such as we suppose to pollute the blood in the pathological condition we are now studying, there may not be an eclectic tendency, for the reason that it has lately belonged, as it were, to the whole system; and if it should direct itself upon the great organs of excretion, it might not be able to rouse them from their torpor. It is left, then, to irritate the serous and areolar membranes, and increase their exdosmosis: a *passive* function, for which they are at the time so much the better fitted, as they are the more relaxed or reduced in texture and vital force by the previous fever. In this way appear to be generated those dropsical accumulations, which we are now studying; to the more rapid increase of which a defective absorption may be an auxiliary cause.

III. Treatment.—Let us test these hypotheses by studying the therapeutics which they demand, and comparing them with what experience has shown to be successful. *First.* Should a subacute inflammation of any abdominal organ or tissue, still remain, it should be subdued. *Second.* The great excretory functions must be reëxcited; and, some one at least, brought, for a while, into greater activity than in health. *Third.* Absorption must be promoted. *Fourth.* The blood must be renovated, and the tone of the solids restored.

Such are the indications to be fulfilled, and they demand the very means which are known to be most efficacious; the study of which, in detail, must now receive attention.

1. When subacute peritonitis, hepatitis, or splenitis, or any complication of them, is known to exist, bloodletting, general and topical, must be the

first remedy; under the free resort to which an immediate improvement often takes place; for secretion will be diminished and absorption promoted. As to other antiphlogistic measures, they are so much the same with those required to fulfill the next indication, that they need not be here enumerated.

2. To reëxcite the excretory functions, the means specifically adapted to each must be employed, but not at the same time. In fixing on any one with which to begin, the physician must exercise his sagacity. If the bowels have been torpid and costive, he may select them; if the liver, it; if the kidneys, them; he may even choose the skin and be successful. In administering the agents, respectively, appropriate to these great secretory outlets, if there be some degree of phlogistic diathesis, from visceral inflammation, he must choose the refrigerant and sedative. On the other hand, if the vital forces be greatly reduced, he should select the most exciting, and often administer stimuli at the same time, or the evacuants will not promote excretion. But a measure, preliminary to all others, may be the administration of an emetic, which tends to arouse the organs, generally, into increased activity, and gives greater efficacy to all that is subsequently done.

If the liver and bowels be fixed upon, as the first to which our remedies are to be directed, five grains of calomel or blue mass, with an equal quantity of Dover's powder, should be administered at bed time; and, the following day, two scruples or a drachm of a powder, composed of equal parts of jalap, nitre, and cream of tartar; to be aided in its operation, if necessary, with an infusion of senna and epsom salt. On the following night, the calomel and Dover's powder should be repeated, and, on the next day, the hydrogogue. This course may be pursued for three or four days, according as the strength of the patient seems, or does not seem, to admit of it. But, as a substitute for the cathartics mentioned, a sixth of a grain of elaterium and a scruple of cream of tartar, may be administered every two hours, beginning early in the morning, and continuing it until purging is produced. If, by these means, copious watery discharges, colored with bile, are effected, a rapid absorption of the effused fluid, and a consequent reduction of the swelling, will take place. Should the quantity of Dover's powder, mentioned, be found too small to produce tranquillity and sleep at night, it must be increased; and should the purging reproduce the ague, five or ten grains of sulphate of quinine, must be added to the opiate.

If this course should not have been adopted, or have been prosecuted without effect, the physician must determine his efforts upon the kidneys. He may still, however, act upon the liver with calomel or the blue mass, in conjunction with diuretics. A composition which, perhaps, exerts more power in these cases than any other, is two grains of one of the mercurials just mentioned, two of squill, and eight or ten of nitre, intimately incorporated, and administered, in the form of a bolus, every two hours, until the secretion of urine is augmented; and, then, every four hours, omitting the mercurial, if signs of approaching salivation should appear. As it will not affect the kidneys, should it act on the bowels, opium may be necessary. After this course has been continued for a few days, a copious flow of urine will, in general, take place; and, at the same time, a diminution of the swelling will denote the progress of absorption. Other sedative diuretics are employed in the Valley; of which I will only mention, as the best, an infusion of digitalis with the spirit of nitrous ether, taken in a solution of cream of tartar; and the hydriodate of potash, in ten or fifteen grain doses, three or four times a day.

Of stimulating diuretics, the oil of turpentine, in such doses, as will not purge, often does good; and in cases of great torpidity, the tincture of cantharides, may be given until strangury is excited, after which one of the compounds mentioned above, will keep up the discharge. Gin and water, or, even whisky and water, are well adapted to cases of this kind. An infusion of green tea, taken cold, often produces a decided effect. My preceptor, Doctor Goforth, was exceedingly partial, in these cases, to the following popular and domestic formula:

℞. Parsley root, - - - - - - - - Horse-radish, - - - - - - - - Black mustard seed, - - - - - Juniper berries, - - - - - - -	each ℥iv, bruised.
Squill, - - - - - - - - - - - Rust of iron, - - - - - - - -	" ʒss.

Mix and infuse in a gallon of hard cider, for three days, in a covered vessel, and then, immediately after strong agitation, pass the liquid through a thin strainer, and bottle. The dose is from two to four ounces, four or six times a day. That the undissolved carbonate of iron, may be taken, the bottle should be agitated before pouring out the dose. I have repeatedly prescribed this compound with the happiest effects; and it is generally acceptable to the patient, because, he regards the ingredients as *simples*.

In general, the diuretic treatment should be continued longer than the purgative; but there are limits beyond which it should not be carried, and the physician ought, at length, to turn his attention to another great function, that of the skin. This may, indeed, have been already done to some extent; for when Dover's powder was administered at night, and the purging was suspended, some influence was necessarily exerted on the external surface. The restoration of its functions should now, however, become the main object, and, therefore, neither cathartics nor diuretics, should be administered. In the prosecution of the diaphoretic plan, warm bathing, local or general, with frictions and shampooings, should be employed; and ten grains of Dover's powder, with five of sulphate of quinine, given, once or twice every night, with hot infusions of balm, sage, sassafras, thoroughwort, or serpentaria. When, however, the powers of the system are greatly reduced, hot gin, or whisky toddy, should be preferred; or one of those stimulants should be added to one of the infusions just mentioned. In the day time, the patient should be kept in bed, or at least within doors, otherwise the perspiration will be checked. Many years ago, Doctor Allison, who had been Surgeon-General of Wayne's Army, told me, that he had cured a female patient of anasarca, following on intermittent fever, by making her drink hot gin toddy, and dance daily to fatigue, in a warm room.

The excitation of the absorbents, has been stated as one of the objects to be accomplished. It may, indeed, be said to be the great end in view. But, it will be perceived, that very little remains to be said under this head; for all that has been advised, has contributed to fulfill this indication. Moreover, of medicines that act specifically on the absorbent system, we know but little. Nevertheless, it seems probable, that digitalis exerts an effect of that kind; as we seldom observe diuresis under its administration, except when there are dropsical effusions; which, being absorbed, irritate the kidneys into increased secretion. There is little doubt, moreover, that iodine exerts an influence on the absorbent system; and hence, perhaps, in part, the efficacy of the hydriodate of potash, in the diseases under consideration. But there are means of a different kind, for promoting absorption — these are compression and exercise. As a general rule, bandages will accomplish but little, till the absorption has commenced; when they should never be omitted, from both the limbs and abdomen, if the disease exist in both. Of the power of exercise over the absorbent system, there can be no doubt. When the abdominal distension is great, it cannot be taken, because the diaphragm cannot descend; and if there be enlarged spleen, the difficulty will be much increased. But in the treatment of anasarca, the value of active, or sustained locomotion, will be decisive. Its effects are not limited to the action of the muscles upon the veins and lymphatics; but found, likewise, in the increased exhalation from the lungs, from deeper and more frequent inspirations, which tend, at once, to the elimination of the absorbed fluid, as if from the skin or kidneys; and to an improved condition of the impoverished blood. And this brings us to our last indication — the restoration of the flesh and strength of the patient.

Tonics, scarcely ever to be omitted, after the absorption of the serum has been effected, may, in many cases, be advantageously administered before. For example, when there is still a strong tendency to the recurrence of the febrile paroxysm, under slight exposure, or at quartan, or heptan periods, the bark, alone, or combined with cream of tartar, will contribute to diminish effusion and promote absorption, as well as arrest the recurrence of the Fever. And, when the effusion has suddenly become very great, with a feeble pulse, and cool or cold, bloodless, and semi-transparent skin, that medicine, and the proto-carbonate, proto-tartrate, or proto-sulphate of iron, are powerful means of arousing the system into increased absorption and secretion; while they contribute to augment the solid materials of the blood, and thus diminish the tendency to the effusion of serum into the cavities. Of the whole, the proto-carbonate has, perhaps, been most frequently employed; and there is much testimony in its favor. The iodide of iron, and the hydrocyanate of quinine are, also, well adapted to such cases.

The absorption of the serum having been effected, some of the medicines, just named, alternated with vegetable bitters, must be continued for a considerable length of time; great care being taken to keep the secretions, in a healthy condition, by such means as are least debilitating. If *they* should fail, the effusions will recommence. At the same time, compression, frictions, and percussions, should be applied to the limbs; and kneading with the fists to the abdomen, should there be nothing in the state of the liver or spleen to forbid them. The diet of the patient should be mixed and nutritious, but not in excess; and he should take as much exercise in the open air as possible; having the surface of his body well protected.

SECTION VII.

PERIODICAL NEURALGIA.

I. Prevalence, Seasons, and Subjects.—Relying upon the information received of others, in connection with my own experience, I may say, that neuralgia is decidedly the most frequent of all the consequences of autumnal fever. It prevails from north to south — everywhere, indeed, that our periodical fevers occur; but most, where intermittents are most prevalent in comparison with remittents. Doctor Flournoy, of Lexington, Missouri, is the only physician who has told me, that he had seen it *precede* the fevers of autumn. Its subjects, then, were probably those who had experienced attacks of the Fever the year before. In general, it follows the annual epidemic; and, therefore, occurs chiefly in winter, and in spring when vernal intermittents prevail. Occasionally, in certain localities, the number of winter cases is so great, as to constitute it a kind of epidemic. From June to December, it is comparatively rare. It affects adults more than children, and men more than women; at least, this is what I have observed in my own practice. In some cases it becomes so established, as to return with great frequency for years. Such, for a long time, was the condition of the late President Harrison, who resided in a locality infested with intermittent fever. Many years ago, I knew a Philadelphia merchant, who traveled much in the West, and was obliged always to carry with him a quantity of the bark — the only medicine which afforded him relief.

II. Seats and Symptoms.—The true type of this painful affection, and, by far, the most common, is known under the popular name of 'sun-pain;' by the profession called periodical hemicrania. Its common seat is the right or left extremity of the forehead; but it often spreads over the entire orbit of the eye. Occasionally it runs back to the occiput, limiting itself to one side; but now and then it attacks the whole head; raging, however, with greatest intensity in the frontal region, and generally more on one side than other. In some cases the skin of the forehead shows a considerable degree of hyperæmia; but I never saw evidences of inflammation. When it extends to the orbit, the eye becomes red, there is a copious secretion of tears, and considerable intolerance of light. It commonly shows a distinct quotidian, intermittent type; but, in some cases, is tertian; and now and then only remittent. I cannot say, that the paroxysms are never ushered in with a distinct chill; but do not recollect its occurrence in my own practice, nor has it been mentioned to me by others. Although the paroxysm may recur at any time in the twenty-four hours, its legitimate period is the latter part of the night or early in the morning; which, with its gradual increase during the forenooon, and its abatement or entire cessation toward night, has procured for it the name of 'sun-pain.' As it ceases, the redness of the eye, when that organ is involved, diminishes or disappears, and the tolerance of light returns.

As to constitutional symptoms, the liver, stomach, and bowels, are much less disturbed than in relapses of intermittent fever. The pulse is apt to be accelerated during the paroxysm, and, occasionally, there is some development of heat in the skin; but, in many cases, scarcely a single symptom of fever is present.

I must now enumerate other parts of the body, in which this affection has been observed, by those with whom I have conversed; having also witnessed several of them myself.

In the north, Doctor Conant has seen it in various parts of the body; Doctor White saw one case, in which it occurred about the middle of the humerus; Doctors Baker and Kitterage, have seen it in the extremities; Doctor Wallace, in the teeth and side of the chest; Doctor Dresbach, in the sacrum, coccyx, and lower extremities: In one case it attacked the spermatic cord and testicles, and the paroxysms alternated with others in the head, feet, and stomach. In the west, Doctor Price has frequently seen it attack the stomach—in one instance that organ and the diaphragm, the paroxysms coming on regularly at midnight; Doctor McCullough has known it assail the os occipitis, the right side of the chest, and the wrist. To the south, Doctor Christian has had two cases in which it occurred in the splenic, and four in the uterine region; Doctor Kittral has twice seen it in the ear; Doctor Walkly had a case in which, under the influence of electro-magnetism, it shifted to a tooth, then to the external angle of the eye, then to the temple of the opposite side, and then to the arm, when it ceased; Doctor Barnett has seen several cases in which it fell upon the uterus, and, also, upon the tongue; Doctor McMurtery has seen it affect the testicle and the liver; Doctor H. C. Lewis saw a case in which, after a white swelling of the knee-joint, it attacked the gastroenemii muscles of the same limb, and returned the next autumn in the same part. Finally, it is a familiar fact, that the membranes of the jaws, and even the teeth, are often attacked. Thus, I have seen the pain of decayed teeth return at regular, diurnal periods.

In addition to these citations, which show that various parts of the body are affected, I may add, that many cases of what, from their history, are called chronic rheumatism, have such diurnal or nocturnal exascerbations as should, perhaps, entitle them to a place in the catalogue of neuralgias.

Although the affections we are now studying, very commonly follow attacks of autumnal fever, many cases do not. They depend, however, on the same cause; but occur without the intervention of the Fever. This is proven by their prevailing in the same places, having the same symptoms, and being cured or relieved by the same treatment. In general, the cases which have not been preceded by fever, are of the mildest grade. The disease we are now considering, doubtless attacks many parts of the body, not highly endowed with sensibility, and disturbs their functions, without giving the acute pain of neuralgia. Such cases may be detected by their periodicity, and the absence of the signs of inflammation. Professor Gross, whose popularity as a physician equals his fame as a surgeon, has, as he informs me, met with such cases, from the country around Louisville; and they have also occurred in my own practice.

III. Pathology.—Periodical neuralgia, is a pain or aching of the white fibrous tissues; but sometimes of the red; and, perhaps, also of others. The nervous irritation is not generally, or necessarily, of that kind which invites blood into the part, though such a fluxion may be produced. A true inflammatory action is, however, not set up; for the irritation ceases, and with it the hyperæmia, before the inflammation can be established. When it attacks the fibrous membranes of the cranium, it is sometimes mistaken for arachnitis; and I have seen the paroxysms become progressively worse under an antiphlogistic treatment. Why it is oftener seated in the extremities of the fifth pair of nerves, than any others, I cannot tell; but we have long known, that ordinary tic douloureux has its chosen seat in the same nerves. The reason that a part which is affected with periodical neuralgia, does not suffer organic changes, is to be found, I suppose, in the absence of inflammation, the immediate cause of most lesions of structure. This negative character, taken in connection with its periodicity, places the disease among the neuroses, and reveals to us the true character of intermittent fever, as far as the primary impression of the remote cause is concerned. It, also, teaches us why that fever cannot, in general, be arrested by means which only lower the excitement of the system; and why it readily yields to opium and quinine, when the system is brought, by depletion, into, a state favorable to their action. But the disease, in both its febrile and its neuralgic stages, is of a peculiar kind, and, therefore, not every agent which acts powerfully on the nervous system, will arrest it.

IV. Treatment.—I know of no disease, in the treatment of which our physicians are so unanimous, as of that now before us. From north to south it is essentially the same. Everywhere the sulphate of quinine is the popular remedy; and by nearly all it has been found infallible. But this infallibility, in many cases, is limited to an arrest of the paroxysms; which after a while may recur. In fact, this painful affection obeys the same laws as protracted and relapsing intermittent fever. By some physicians, the quinine is administered without any preparation of the system; while others always subject their patients to the operation of emetic and cathartic medicines. There are cases which do not, and others which do, require that preparatory treatment. As a general rule, the longer and oftener, the disease has returned, the less is the necessity for those evacuants; and, of the two, emetics are more beneficial than cathartics. Sometimes, when the quinine has failed before, it has succeeded after, the operation of an active emetic. When the attack is violent, and distinctly marked with diurnal, or nocturnal paroxysms, opium is a valuable adjuvant to the quinine. Thus, a grain of that medicine, or ten grains of Dover's powder, with ten of quinine, may be administered at bedtime; and another dose of the same kind, before day, in anticipation of the paroxysm; which it will generally avert, provided the patient continue in bed during the forenoon. But in some cases the proportion of opium may be doubled. The next night, half the quantity of these medicines will be sufficient. In obstinate cases of long standing, a method, not so prompt, will be preferable. Thus, the bark, in substance, may be administered in drachm doses, three or four times a day. Or a compound of quinine, opium, and arsenious acid, as for relapsing intermittents, may be substituted for it. Doctor Vivian, of Missouri, assured me, that he had found the carbonas-ferri, of much service in some cases of this kind. A variety of local applications have been made. In my own practice they have done but little good. Yet a blister to the nape of the neck, has, occasionally, given immediate relief, the pain being seated in the face or head. Of other applications, over the affected part, Doctor Barnett, of Mississippi, and Doctor W. A. Davison, of Missouri, informed me, that that they had seen veratria afford relief; and Doctor Talbot, of the latter State, has employed a saturated, alcoholic tincture of stramonium seeds with advantage.

The article AUTUMNAL FEVER is now brought to a close. It has extended through many pages; but a smaller number would not have sufficed, to present, even an outline, of its etiological, and therapeutic history; through so wide a geographical range, as that of the southern half of our Interior Valley; in almost every part of which, it is an annual endemio-epidemic. Of all our diseases, it is the one, which has the most intimate relations with soil and climate — that, in which, peculiarities, resulting from topographical and atmospheric influences, are most likely to appear. Hence it was chosen, to stand next to the Book of General Etiology; as illustrating, better than any other disease, the importance, of the facts which make up that Book. It is, moreover, the *great* cause of mortality, or infirmity of constitution, especially in the southern portions of the Valley; and, therefore, entitled to severe and patient attention. What I have collected and presented, has required more labor, than many of our brethren might suppose; and, yet, they will not, perhaps, realize so fully as I do myself, how much must be added — how many errors corrected — before the pages through which they have traveled, can be entitled to universal acceptance. Meanwhile, if what has been written, should stir up a single young physician, to a more diligent observation of the Fever, or save the life of one individual, who might otherwise have become its victim, my labor will not have been in vain.

END OF VOLUME FIRST.

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