1st BIENNIAL REPORT
OF THE
NORTH CAROLINA
Board of Health.

1879--1880.

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NORTH CAROLINA

BOARD OF HEALTH,

1879–1880.

RALEIGH:
News & Observer, State Printers and Binders.
1881.

REPORT OF THE SECRETARY.

OFFICE OF THE SECRETARY OF THE
NORTH CAROLINA BOARD OF HEALTH,
Wilmington, N. C., December 31st, 1880.

To His Excellency, THOS. J. JARVIS,
Governor of the State of North Carolina:

SIR: I have the honor to present to you, according to section 2 of the Act Supplemental to an Act creating a State Board of Health, a report of the work done by the North Carolina Board of Health for the two years ending December, 1880.

Respectfully, your obedient servant,
THOMAS F. WOOD,
Sec. N. C. Board of Health.

WILMINGTON, N. C., December 24th, 1880.

The organization of the North Carolina Board of Health (according to chapter 117, sec. 2, laws of 1879) was begun on the 21st day of May, 1879, in Greensborough, by the election of the following gentlemen from the active list of membership of the Medical Society of North Carolina:

Dr. S. S. SATCHWELL, Rocky Point, N. C., to serve for six years.

Dr. THOMAS F. WOOD, Wilmington, N. C., to serve for six years.

Dr. Charles J. O'Hagan, Greenville, N. C., to serve for four years.

Dr. George A. Foote, Warrenton, N. C., to serve for four years.

Dr. M. Whitehead, Salisbury, N. C., to serve for two years.

Dr. R. L. Payne, Lexington, N. C., to serve for two years.

Subsequently His Excellency the Governor appointed A. R. Ledoux, Ph.D., William Cain, C. E., and Henry G. Woodfin, M. D., as members of the Board on the part of the State.

At a meeting of the members elect in the McAdoo House in Greensborough, on the afternoon of the 21st May, the further organization was completed by the election of S. S. Satchwell, M. D., President; Thomas F. Wood, M. D., Secretary and Treasurer.

The following resolution was introduced by Dr. A. R. Ledoux:

Resolved, That the execution of the Board of Health Law (chap. 117, sec. 2, laws N. C., 1879) shall be entrusted to the Secretary, the details of its provisions being under his management, and that the Secretary make his report to the next meeting of the Board.

Adopted.

Upon motion of Dr. Ledoux, a committee was appointed to confer with the Department of Agriculture to make arrangements for the chemical investigations by the Board. Adopted.

Shortly after the adjournment of the Board, the proper material was placed in the hands of the State Printer, and as soon as the work could be delivered, the machinery of the Board was put in motion.

The first subject to be considered was the organization of County Boards of Health.

The following Circulars were issued:

OFFICE OF SECRETARY N. C. BOARD OF HEALTH,
WILMINGTON, N. C., May 24th, 1879.

Chairman of the County Commissioners:

DEAR SIR: By direction of the North Carolina Board of Health, I have the honor to call your attention to the law passed by the Legislature of 1879, entitled "An act supplemental to an act creating the State Board of Health, which is herewith presented.

It is earnestly desired by the Board that the auxiliary County Boards of Health be organized without delay. It is suggested that notification be served by the Chairman of the County Commissioners upon the physicians* entitled to membership under this act, and also to the Mayor of the County Town, and the City or County Surveyor, and that they proceed to elect from the physicians composing the Board a suitable person for Superintendent. As soon as this organization is completed the enclosed blank "List of Members" must be filled up and returned to this office. Upon receipt of this list, or as soon thereafter as possible, the necessary blanks will be furnished.

Respectfully yours,
THOMAS F. WOOD.
Sec'y N. C. Board of Health.

The organization of County Boards was proceeded with in many counties, so that in September of the year 1879, the following counties had completed an organization:

Alleghany,	Dr. John L. Smith,	Superintendent.
Ashe,	Dr. James Wagg,	"
Brunswick,	Dr. F. W. Potter,	"
Buncombe,	Dr. M. L. Hilliard,	"
Burke,	Dr. W. A. Collett,	"
Cumberland,	Dr. W. C. McDuffie,	"
Cabarrus,	Dr. F. M. Henderson,	"
Catawba,	Dr. James R. Campbell,	"
Cleveland,	Dr. J. C. Gidney,	"

*It may be necessary to explain that to be eligible to membership in the State Medical Society the physician must be a licentiate of the Board of Medical Examiners, or must have commenced the practice of Medicine before the 15th April, 1859. A copy of the Constitution of the State Medical Society, and the Board of Examiner's law, will be sent on application.

Columbus,	Dr. M. R. Morrison,	Superintendent.
Duplin,	Dr. J. D. Roberts,	"
Edgecombe,	Dr. A. H. McNair,	"
Franklin,	Dr. E. S. Foster,	"
Forsyth,	Dr. S. J. Montague,	"
Greene,	Dr. W. C. Galloway,	"
Guilford,	Dr. B. A. Cheek,	"
Granville,	Dr. J. Buxton Williams,	"
Gaston,	Dr. E. B. Holland,	"
Halifax,	Dr. Isaac E. Green,	"
Haywood,	Dr. G. D. S. Allen,	"
Henderson,	Dr. J. L. Edgerton.	"
Iredell,	Dr. Thomas E. Anderson,	"
Johnston,	Dr. R. J. Noble,	"
Lincoln,	Dr. J. M. Lawing,	"
Macon,	Dr. J. M. Lyle,	"
Mecklenburg,	Dr. H. M. Wilder,	"
Montgomery,	Dr. W. A. Simmons,	"
Martin,	Dr. Joshua Taylor,	"
Mitchell,	Dr. R. C. Brown,	"
New Hanover,	Dr. J. C. Walker,	"
Nash,	Dr. R. A. Sills,	"
Onslow,	Dr. W. J. Montfort,	"
Pender,	Dr. W. T. Ennett,	"
Pitt,	Dr. Wm. M. B. Brown.	"
Person,	Dr. J. T. Fuller,	"
Polk,	Dr. J. G. Waldrop,	Correspondent.
Robeson,	Dr. R. F. Lewis,	Superintendent
Richmond,	Dr. J. M. Covington,	"
Rowan,	Dr. J. J. Summerell,	"
Randolph,	Dr. W. A. Woollen,	"
Stokes,	Dr. L. H. Hill,	"
Sampson,	Dr. C. Tate Murphy,	"
Tyrrell,	Dr. A. C. Alexander,	"
Transylvania,	Dr. J. Cain	"
Union,	Dr. Isaac H. Blair,	"
Wake,	Dr. James McKee,	"
Wayne,	Dr. M. E. Robinson,	"
Warren,	Dr. Geo. A. Foote,	"
Watauga,	Dr. W. B. Council	"
Wilkes,	Dr. R. T. Hackett,	"

During the year 1879, letters of enquiry were frequently received by the secretary asking about the method of organization, and the following circular was issued :

NORTH CAROLINA BOARD OF HEALTH,
Office of the Secretary,
Wilmington, N. C., June, 1879.

To the County Superintendents of Health:

In reply to questions frequently received by letter, as to the duties of County Superintendents of Health, the following general items of information are given :

THE DEATH RATE.

Preliminary to all work, the death rate should be carefully registered. It will be impracticable for the Superintendent to know, personally, of deaths and their causes in his county ; and in order to aid in the collection of these statistics, memorandum books are furnished for distribution, not only to members of the County Board of Health, but also to all practitioners of medicine in the county. In addition to this, No. 6, death certificate, is furnished for distribution. In some sparsely settled counties deaths occur and there is no attending physician to give the certificate. In such cases it is best to send a blank to the officiating minister, as an unprofessional record is better than the failure to get the return.

DISEASES DANGEROUS TO THE PUBLIC HEALTH.

When such diseases occur, all diligence should be used to make early enquiry as to the origin of the first case, and prompt means adopted to quarantine them according to Section 9 of the Health Law. The physicians' and householders' blanks are furnished for distribution to physicians and intelligent householders, that all items necessary to complete the history of the invasion of the diseases mentioned may be investigated and written up.

MEDICO-LEGAL POST-MORTEM EXAMINATIONS.

With a view to a uniform system for investigations under this head. a pamphlet containing minute directions, founded upon the German Law of 1876, has been prepared, and it is earnestly desired that the returns of examinations will be made complete.

BLANK "B" RETURNS.

The blanks issued are intended to be returned annually. A careful reading of it will show the scope of the observations necessary to carry out the design. The work could be entrusted to the members of the County Board of Health from the different townships, to whom a blank may be issued with explanations. The advice of the city or county surveyor in the general report would aid the more accurate composition of the report. To elucidate the topography, sketch-maps of townships would be highly esteemed by the State Board of Health, with an ultimate view to publication. If these reports are fully made, the labor of making a sanitary map of the State will be materially lessened.

DRINKING WATER.

By consultation with Professor Ledoux, the Chemist of the Board, a plan has been agreed upon, which will enable him to make for the Board an examination of the drinking waters in the State. The secretary especially desires the co-operation of Superintendents of Health in this work. It is desirable that several specimens of drinking water should be selected from every county, keeping always in view the necessity of having representative specimens, that a general idea may be obtained of the condition of wells and springs in a given neighborhood, town or city. Specimens recommended by superintendents will have early consideration from the secretary. In every case the packing must be done in accordance with Dr. Ledoux's circular, and the freight expense borne by the applicant, as no means have been given the Board for this purpose.

VACCINATION.

It must be insisted on, that every person entering the poor-house, work-house and jail of the county shall be vaccinated by the superintendent upon his first visit after new inmates have been received, except in such cases in which he is satisfied that the persons are already protected. Our State has been so long exempt from visitations from small pox that it is highly desirable that vaccination, the only certain prophylactic known, should be generously employed, that we may have continuous exemption. A pamphlet is in preparation on this subject, which will put before superintendents much of the neglected literature of vaccination brought down from the Jennerian times. Vaccine will be furnished according to the provisions of Section 11 of the Health Law.

ABATEMENT OF NUISANCES.

In proportion to the diligence and intelligence with which the County Superintendent carries out Section 10 of the Health Law will greatly depend the sanitary condition of towns. Blanks are issued for the purpose of notification, and will be furnished on application.

Superintendents of Health should furnish, as soon as practicable, a complete list of the members of the Board of Health in their county. This only includes those who are actually present at the meeting of organization, or who connect themselves with the Board afterwards. To such members will be sent all the printed matter issued by the State Board, and their assistance and co-operation are earnestly desired.

PERMITS FOR BURIAL.

It will promote the accuracy of mortuary statistics if the County Boards of Health will use their influence to have a rule made by the city corporations and cemetery associations, forbidding the burial of any person until a certificate is given by the last attending physician of the cause of death. This plan is largely adopted already, and is not considered burdensome by any.

Letters of enquiry upon any matters connected with the work of the State Board will be promptly answered; and suggestions looking to the advancement of the interests of the North Carolina Board respectfully solicited.

THOMAS F. WOOD, M. D.,
Secretary,

The work of organization of County Boards of Health was fraught with numerous difficulties. When it was understood that the Superintendent of Health was not only the adviser of the people and officials in respect to the health of the county in which he served, but was also physician to the poor-house, work-house and jail, and was expected to keep a register of vital statistics, and make a monthly report to the Secretary of the State Board, very few physicians were willing to undertake the work, and more especially as the pay for services was small in most counties.*

A few Superintendents commenced their work with zeal, but finding that their success was dependent upon the aid they could get from the physicians composing the county board, and that reports from these gentlemen were fitful and uncertain, they abandoned the work to others.

It was at first thought possible that a complete record could be obtained of all persons falling sick with certain *diseases, dangerous to the public health*, and that deaths would be accurately returned. This was very desirable, but the machinery proved entirely inadequate to the accomplishment of the plan. Some physicians sent in their monthly statement of diseases and deaths with commendable punctuality, but the total number as compared with the failures in the counties not reporting, made the reports valueless for comparison.

The plan set on foot for the collection of statistics was as follows:

Every physician was supplied with a memorandum book, printed and ruled for every month in the year, with the request that every month he should send in his report to the Superintendent of the county. In addition to this, blanks were distributed to householders and intelligent citizens in order to facilitate the collection of statistical items in regions where a physician was not at hand. This whole plan of reporting was too imperfectly done, for reasons to be hereafter explained, to be of any value. After careful consideration the method was changed, and the plan here

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*NOTE.--The law only gave the Superintendent such amount as was spent in the year 1878 for medical attendance on the jail and poor-house and work-house, and the amount paid for medico-legal examinations at coroners' inquests. In some counties this was nothing, and in many of them it was very small, and the Superintendents undertook their duties, impelled alone by their pride and the interest they had in the work which had been inaugurated by the State Medical profession.

substituted has been continued for the year 1880, with results as seen in reports on pages.*

The following circular was issued with instructions:

Office of the Superintendent of Health............County.

Population of County..................Post Office,...............................N. C.
Population of county town......................Date,...............................188....

To the Secretary of the North Carolina Board of Health:

For the month of...............the prevailing winds have been................ and there ha.... been................rainy days.... ; there ha.... been .... day.... of snow ; the average temperature has been.........degrees.

The prevailing diseases have been.. and in[1]..

.........[2] cases of Small Pox ha.... occurred.
.... " Measles ha.... occurred.
.... " Whooping Cough ha.... occurred.
.... " Scarlatina ha.... occurred.
.... " Diphtheria ha... occurred.
.... " Yellow Fever ha.... occurred.
.... " Typhoid Fever ha.... occurred.
.... " Pernicious Malarial Fever ha.... occurred.
.... " Cholera ha.... occurred.
.... " Hœmorrhagic Malarial Fever h.... occurred.

The diseases among domestic animals, coming to my knowledge, are as follows:

There has been [3]......... epidemic of [4]................ prevailing.

[5]Remarks on Condition of Public Buildings:

There are......prisoners confined in jail.
There are......prisoners confined in work-house.
There are......inmates of the poor-house.

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* Refers to pages of tabulated reports.

	Jail.	Work-house.	Poor-house.
Each has the following cubic space, in feet,	....	....	....
The [6]water served to each is	....	....	....
The [6]food served to each is	....	....	....
The number giving evidence of successful vaccination,	....	....	....
The number giving no evidence of successful vaccination,	....	....	....

* The condition of the wells is[7]..

The condition of the privies is..

The public school houses in this county are [8]...... in number ; [8]...... are built of logs ; [8]........ are built of boards ; [8]........ are built of brick. Are they sufficiently warmed ?[9]......... Are they sufficiently ventilated ?.........

Are the privies of males and females separate ?[9]........ ; are the privies in good condition ?[9]........ on the ground[9]........ ; with a vault ?[9]........ ; dry earth closet ?[9]......

Has there been any new work upon drainage of streets in county town this month ?[9].........

Are any efforts being made towards the improvement of the sanitary condition of county town ?[9]......... ; of public buildings ?[9].........

Give a detailed statement of any effort employed by you to get the attention of the public towards sanitary improvement, enclosing any printed matter issued by you..

....

General remarks upon any matter appertaining to the sanitary condition of the county, and any suggestions looking to a more careful collection of reports..

....

[1] State the locality, such as on river-course, undrained land, high hills or mountains, &c., &c. [2] State the actual number of cases of the diseases if known, otherwise, give it in general terms. [3] Insert the word *an* or *no*. [4] Name of disease. [5] To be filled up monthly. [6] State whether in sufficient quantity and quality. [7] State whether soft or hard, or dangerously or offensively close to the privy. [8] State number. [9] Answer yes or no.

NOTE.—In cities where State buildings are located, a monthly report should be made of their sanitary condition.

*Reference is here made to wells in the county town.

THE COUNTY SUPERINTENDENTS OF HEALTH.

According to the law (section 5) the duties of the County Superintendent of Health shall be "to gather vital statistics upon a plan designated by the State Board of Health. He shall make the medico-legal *post-mortem* examinations for Coroner's inquests, and attend prisoners in jail, poor-house and work-house. His reports shall be made regularly, as advised by the State Board through their Secretary, and he shall carry out, as far as practicable, such work as may be directed by the State Board of Health."

The collection of vital statistics has been already mentioned, and will be taken up more fully hereafter.

As the law made the County Superintendent the medico-legal examiner of the county, it was deemed necessary to prepare a manual on the method of performing *post-mortem* examinations, in order that these examinations should be uniform and accurate. Accordingly such a pamphlet was prepared and distributed in July, 1879. (See appendix A.)

In addition to this work, which also included the preparations of viscera, fluids of the body, &c., for examination by the Chemist of the Agricultural Station, the Superintendent was made, by law, the physician to the penal and charitable establishments of the county. So that, while being the sanitary adviser of the citizens of the county in which he served, his office was no sinecure, but a position requiring skillful and diligent service, without adding to the expense of the county.

PAMPHLETS ISSUED BY THE BOARD.

In addition to the "Methods of Performing Post-Mortem Examinations," in June, 1879, as the summer season approached, a pamphlet was issued on "Disinfection, Drainage, Drinking Water and Disinfectants." (See Appendix B.) So much interest was awakened by the issue of this pamphlet, that Prof. William Cain, C. E., member of the State Board, was requested to prepare a paper elaborating the topics of the first. This was done in a pamphlet entitled, "Sanitary Engineering." (See Appendix C.)

Later in the year diphtheria became quite prevalent in many parts of the State, and Dr. R. L. Payne, member of the State Board, prepared, at the request of the Secretary, a pamphlet on the "Limitation and Prevention of Diphtheria."

So many demands had been made for Prof. Cain's first treatise, that he kindly consented to prepare a more elaborate work under the same title as the former:

"SANITARY ENGINEERING."—)Appendix C.)

This valuable work, of which a large edition was printed, was exhausted within a few months after its publication.

DRINKING WATER.

Believing the most important lesson to inculcated was the consideration of drinking water in its sanitary aspect, the attention of the public was called to the subject by means of the pamphlets already mentioned, and through the public press. One example served to excite attention to the subject The circumstances are so interesting as to be worthy of recital at this place.

A family residing upon the summit of a sand-hill, on a rather thickly built street in Wilmington, had suffered severely from sickness during a long period. The house was of wood, surrounded by dense shrubbery. The well from which the family drew its supply of water was located in what was considered a favorable spot. The sickly condition of the children caused the head of the family great anxiety. Shrubbery was cleared out to allow free access of light and air. The house was carefully cleaned underneath and whitewashed; its ventilation was improved; but still the sickness was unabated. Attention was called to the drinking water, not heretofore suspected, and a specimen analyzed by the Chemist of the Board.

The result of the analysis was the revelation that foul impurities, the leaching of a neighboring privy, were found in the water. The well was abandoned and the water supply secured from another source, and the result was marked.

This circumstance attracted the attention of others to their drinking water, and enquiries came to the Board from many directions.

The result of these examinations is given below.

The form for conducting the examinations was designed by Dr. A. R. Ledoux, Chemist of the Board of Health, as follows:

LABORATORY OF STATE BOARD OF HEALTH,
Chapel Hill, N. C., June 20th, 1879.

ANALYSIS FOR STATE BOARD OF HEALTH.

By an act of the Legislature of 1879, entitled, "An act supplemental to an act creating a State Board of Health," the Chemist of the State Experiment Station was made Chemist to the Board of Health. In compliance with the requirements of the law, the Station is prepared to make such analyses as may be approved by the Secretary of the Board. The following

INSTRUCTIONS FOR SENDING SAMPLES

must be carefully complied with by those wishing to avail themselves of the facilities afforded by the laboratory of the Station and provided by the law:

1. In cases of suspected poisoning, the Coroners and County Superintendents of Health must comply with special instructions which have already been sent them, or which may be had on application.

2. Analyses of articles of food, drugs, etc., examinations in cases of suspected adulteration of foods and medicines, and investigations desired in connection with the hygienic duties of the Superintendents of Health, will be undertaken when authorized by the Secretary of the Board.

3. Parties desiring a chemical examination of the waters of public or private wells must first write to Dr. Thomas F. Wood, Secretary State Board of Health, Wilmington, for permission. They will then proceed to obtain a sample according to the following directions. These directions will also be complied with by agents of the Board, taking samples of water by their order: Secure one or more glass bottles, or a demijohn, which will hold at least two gallons. These bottles must be PERFECTLY CLEAN (better new.) When possible, secure a sample by letting the bottle down into the well, being careful not to stir up the bottom or touch the sides. Cork tightly with *new* corks and seal with wax. Mark each bottle with designating numbers. Pack in saw-dust, straw or tan-bark, and *pre-pay the express charges* to Chapl Hill.*

Having sent the samples, directed to THE EXPERIMENT STATION, fill out and send by mail the accompanying blank. Samples sent during the winter run great risk of freezing and bursting the bottles.

By order of the Board of Health:

A. R. LEDOUX, Chemist.

BLANK.

Dr. A. R. Ledoux:

SIR: I send by express to-day .... sample.. of water, drawn by order of the Secretary of the Board of Health, on the ...... of ...., 18..., from .... well.., in the town of ...., and marked as follows:.........

REMARKS:...

Yours truly,

[Signed]......................

The following analyses of drinking water were made for the North Carolina Board of Health and reported by the Chemist of the Agricultural Experiment Station, with his comments thereon:

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*The analyses will be made free of charge to the sender, but the Board of Health has no funds with which to pay express charges.

SOME OF THE DRINKING WATERS OF NORTH CAROLINA.

The Station having been for a considerable time occupied in examining drinking waters it will be, we think, instructive to report here in collected form our results.

The healthfulness of a water is determined by a partial analysis which determines the total solids, Chlorine, "Free and Albuminoid Ammonia, and the poisons metals."

Water containing undue amounts of organic filth are very injurious to health. They are often the cause of cholera, typhoid fever, diarrhœa, &c. From the amount of free and albuminoid ammonia and of chlorine we are enabled to judge whether the water contains any such contamination.

Chlorine alone does not necessarily indicate a filthy water. More than five grains per gallon of chlorine, accompanied by more than 0.08 parts per million of free ammonia, or more than 0.10 parts per million of albuminoid ammonia, is a clear indication that the water is contaminated with sewage—decayed animal matter, urine, &c. These are of course, the most dangerous waters.

More than 0.10 albuminoid ammonia, without much chlorine, or more than 0.08 parts per million of free ammonia, is evidence of contamination from vegetable matter—rather a bad water, though not positively so dangerous as that containing animal matter.

Free ammonia over 0.08 parts per million and albuminated ammonia over 0 10 parts per million render a water very suspicious, even without much chlorine.

Total solids should not exceed 35 grains per gallon in drinking waters. More than this, accompanied by an excess of albuminoid ammonia, renders the water very bad.

Our remarks upon the waters in the following tables are based on these rules. Look at the results and see what unhealthy, in many cases what dangerous, waters the people have in the places named been drinking.

Through the efficiency of our Secretary of the State Board of Health, we have been enabled to examine quite a large number of waters from Wilmington. It will be seen that they are almost uniformly bad. There is evidence of organic contamination in most of them. Some are positively dangerous from distinct sewage contamination.

Some of the waters examined from Durham show evidence likewise of organic contamination, though not quite so bad. Those from Goldsboro are rather better.

There are not as yet data enough to generalize upon, but these facts are sufficient to indicate that the proper surface drainage and cleaning of wells and springs are very much neglected in most cases.

See to it what sort of waters you are drinking! Send for our directions how to take a sample of water, and get the permission of Dr. Thos. F. Wood, Secretary State Board of Health, Wilmington, N. C., to have your waters analyzed.

CHAS. W. DABNEY, Jr.,
State Chemist.

ANALYSES OF DRINKING WATER.

Date when Drawn.	Name of Sender.	Marks.	Total solids in grains per gallon.	Chlorine in grains per gallon.	Free Ammonia in parts per million.	Albuminoid Am. in parts per million.	Other Constituents Qualitatively.	Remarks.
	From Wilmington.							
Sept 2, 1879.	H. G. Smallbones,........	Well water, ...	24.99	8.90	0.10	0.29	....	Dangerous.
Oct. 8, 1879.	H. Westerman, Esq....	Tank water,........................	2.94	0.40	0.02	0.15	....	Remarkably pure.
" "	" "	Well water, ...	21.70	2.55	0.01	0.16	....	Very suspicious.
" "	Dr. Thos. F. Woods.....	....	13.86	2.20	0.09	0.13	Carbonate of Lime,......	Not safe.
" "	Mr. Meginney...............	Well water,........................	22.80	3.40	0.08	0.15	....	Susp't sewage cont'ion
	Dr. Thos. F. Wood,......	Mr. Lloyd's spring, Market St.,	28.00	6.05	....	....	....	Suspicious.
Oct. 9, 1879.	B. H Ahrens, Esq.,.....	Well water,........................	21.86	3.20	0.04	0.50	....	Very bad.
Jan. 3, 1880.	Wm. T. Daggett, Esq.,	Well water,........................	75.70	9.40	0.06	0.38	Carb. of Lime and Mag.	An abominable water.
	Dr. Thos. F. Wood,.....	Spring water, Market Sr't., bet. 14th and 15th, North side,.......	10.80	1.10	0.04	0.18	....	Fairly good.
	" "	Well water Nat. Cemetery,.......	10.00	1.20	0.04	0.30	....	Not good.
	" "	Well of G. W. Williams, Esq....	13.70	2.50	0.06	0.41	....	Suspicious.
	" "	Cape Fear River, ft of Castle St,	7.20	0.90	0.21	0.44	Suspended matter,......	Rather suspicious.
Jan. 29, 1880.	" "	Well of R. B. Wood, Jr.,............	14.70	1.75	0.08	0.22	....	Suspicious,
	" "	Smith's Creek, at Little Bridge,	6.00	1.30	0.08	0.20	Suspended matter,......	Not good.
	" "	Smith's Creek, at Hilton,..	5.70	1.20	0.08	0.18	Suspended matter,......	Not good,
	" "	Well of Dr. Bellamy, 4th Street, bet. Chestnut and Mulberry...	23.20	2.40	0.03	0.12	Matter in suspension,	Hardly good.
	" "	Well of Jos. McLaurin, Esq.,....	12.50	3.00	0.32	0.38	Matter in suspension,	Susp't org. cont'nation
	" "	Well of Joseph McLaurin, after cleaning,..............................	11.04	1.90	0.03	0.08	....	
	" "	Well of Walker Meares, Esq.,....	14.10	2.60	0.03	0.09	....	Good water.
	" "	Driven pump in Dr. Wood's yard,..............................	22.00	2.70	0.03	0.11	Suspended matter,......	Rather good.
	" "	Corner of 8th and Market Sts,...	30.60	6.70	0.00	0.18	" "	Bad.
	" "	Spring S. W. corner Dock and 2d Streets,..............................	25.00	3.20	0.02	0.07	" "	Rather good.
Sept. 3, 1880.	F. W. Foster, Esq.,.......	No. 1, A,..............................	4.79	1.60	0.34	0.30	Organic matter in susp	Not good.

Sept. 1, 1880.	F. W. Foster, Esq	No. 2, B,	4.60	1.65	0.21	0.26	Organic matter in sup.	Not good.
Sept. 1, 1880.	" "	No. 3, C,	6.70	1.70	0.05	0.30	" "	Hardly good.
Sept. 4, 1880.	" "	No. 4, D,	7.70	1.80	0.16	0.36	" "	Not good.
Nov. 9, 1880.	A. K. Walker, Esq.,	Cistern water,	4.10	0.30	0.16	0.08	Suspended matter,	Hardly good.
" "	" "	Cistern water,	2.10	0.30	0.05	0.08		Good water.
	DURHAM.							
Feb. 3, 1880.	W. T. Blackwell & Co.,	No. 1, well,	20 00	2.20	0.20	0.25		Susp't org. cont'nation
" "	" "	No. 2, well,	25.09	4.00	0.48	0.27		Very bad.
" "	" "	No. 3. well R. R.,	21.70	3.40	0.10	0.20		Quite suspicious.
March, 1880.	J. S. Carr, Esq.,	C. J. S. C.,	10.64	0.50	0.05	0.16		Hardly good,
" "	" "	Well No. 2, J. S. C.,	27.44	3.20	0.08	0.22		None too good.
" "	" "	No. 3 by warehouse well,	16.38	1.30	0.08	0.16		Hardly good.
Nov. 15, 1880	R. E. Carr,	1,	9.30	1.30	0.02	0.07		Good water.
" "	" "	2,	20.50	3.70	0.04	0.16		Rather suspicious.
" "	" "	3,	15.60	1.20	0.02	0.07		Good water.
" "	" "	4,	5.90	0.50	0.13	0.08		Hardly good.
" "	" "	5,	13.70	1.50	0.03	0.09		Rather good.
	GOLDSBORO.							
Feb. 24, 1880.	Dr. M. E. Robeson.	Hill Pump, No. 1,	26.80	9.10	0.08	0.18		Very suspicious.
" "	" "	Hill Pump, No. 2,	74.28	32.00	0.04	0.15	Considerable salt	Absolutely unfit for [drink'g.
" "	" "	Hill Pump, No. 3,	4.00	1.00	0.04	0.06		Good water.
" "	" "	Hill Pump, No. 4,	10.64	3.45	0.05	0.09		Hardly good.
" "	" "	Hill Pump, No. 5,	21.50	3.90	0.04	0.12		Little suspicious.
	CHARLOTTE.							
Feb. 24, 1880.	H. M. Wilder, Esq.,	Well A,	14.14	1.60	0.08	0.10		Good water.
" "	" "	Well B,	76.30	14.00	0.16	0.16		Bad drinking water.
" "	" "	Well C,	78.90	8.50	0.04	0.18		Bad drinking water.
	SALISBURY.							
May 14, 1880.	D. L. Bringle, Esq.,	Spring water A,	13.20	0.50	0.08	0.18	Carbonate of Lime,	Suspicious, needs [clean'g.
Nov. 9, 1880.	Theo. F. Klutz, Esq.,	Well water B,	79.80	12.50	0.24	0.20	" "	Dangerous.
	HICKORY.							
Sept. 29, 1879.	J. F. Murrill, Esq	Well of J. L. Lyerly,	2.10	0.00	0.10	0.12		Rather good.
" "	" "	Well of A. W. Johnson,	2.94	0.00	0.05	0.13		Rather good.
" "	" "	Well of the Rev. Carpenter,	1.19	0.00	0.02	0.08		The purest water rec'd [at the Station.
	RALEIGH.							
Aug. 20, 1879.	Dr. Jas. McKee,	Well Federal Cemetery,	7.42	1.12	0.06	0.08		Unusually pure.
	LINCOLNTON.							
Oct. 2, 1879.	J. M. Lauring, Esq.,	A,	91.00	38.10	0.01	0.20		Extraordinary amou't [of salt.
	SMITHVILLE.							
Dec. 19, 1879.	Dr. Thos. F. Wood,	This wates is used by persons attending court in Brunswick county, G. W. Potter, Supt. Bo'rd of Health Brunswick county, N. C.,	8.96	1.60	0.10	0.25		Hardly good.

ANALYSES OF DRINKING WATER.—*Continued.*

Date when Drawn.	Name of Sender.	Marks.	Total solids in grains per gallon.	Chlorine in grains per gallon.	Free Ammonia in parts per million.	Albuminoid Am. in parts per million.	Other Constituents Qualitatively.	Remarks.
	Edgecombe County. Hon. K. P. Battle,	Dunbar Plantation, Edgecombe county,	5.88	0.28	0.05	0.07	......	Remarkably pure.
Sept. 29, 1880.	Lincoln County. Alfred Nixon, Esq,	Well water,	29.10	12.10	0.24	0.09	......	Very suspicious.

The lessons which these anylses taught were given from time to time in the daily papers. The public mind in Wilmington became agitated on the question of water supply, and the matter is to be remedied by the erection of water-works at no distant day.

From this lesson, up to others quite as essential for the well-being of the citizens of North Carolina, it is the design of this Board to lead the people.

VITAL STATISTICS.

The perplexing subject of vital statistics has always recurred during our work. We were constantly beset with the fact that without a knowledge of the prevailing diseases and the extent of insanitary conditions, we could not act intelligently in pointing out special sanitary defects and their remedies.

In another view of the case, we deemed it essential to the success of the State in inducing immigration that we should be able to issue all the items we could collect for the information of the people who would be likely to seek for homes in America. We were well satisfied that the general statement that this or that county was "healthy" would have but little weight with persons casting about for new homes. Specific official statements would alone serve to assure such enquirers, and these were not to be had. We made application to do the work of collecting vital statistics to the Board of Agriculture, but it was decided that as desirable as the object was money could not be directed from its specific use without authority.

Not discouraged by this failure, we undertook the work alone, with no means save the very small sum of two hundred dollars a year appropriated by the General Assembly.

We submit the results below, not because we believe them to be what they should be, but to show how determined the

Board has been to enter upon a work so essential to the interests of immigration.

I have tabulated, (see Appendix D,) for each county the reports collected from our Monthly Bulletin, quite conscious of their glaring imperfection as compared with what is desired and proposed to be done when our means are increased. I do not wish to disguise either the apathy or carelessness of some of those gentlemen who from their official connection with our work morally pledged themselves to its support, but who, when the drudgery of observing and reporting was requested by the Superintendent of Health in their county, did not put forth a single effort to sustain him, and what was worse, in one instance, took sides with the avowed opponents of the work.

The expenses of the Board paid by the Treasurer are as follows:

For 1879.

Jan.	2d, Traveling expenses of Dr. Wood to Washington,	$40 00
"	21st, Traveling expenses of Dr. G. A. Foote,	10 00
"	21st, " " " Dr. S. S. Satchwell,	25 00
"	21st, " " " Dr. Thos. F. Wood,	16 00
"	19th and 20th, Telegrams,	1 50
"	" "	2 77
Feb'ry	4th, "	95
May	24th, Traveling expenses to Dr. Ledoux,	10 00
Nov.	2 years' subscription Medical Journal,	6 00
	Express,	18 20
	Postage,	53 85
	Postal Cards,	12 50
	Printing,	12 50
	Pigeon Holes for desk,	5 25
	Engraving,	14 50
	Clerk Hire,	240 00
	Total for 1879,	$469 02

For 1880.

May 15th,	Traveling Expenses of Dr. Wood to Washington,	$40 00
"	Postage,	49 36
"	Express and freight,	26 61
"	Office expenses,	7 00
"	Clerical help,	240 00
	Total for 1880,	$362 97
	Total for 1879,	469 02
	Total expenses for two years, 1879 and 1880,	$831 99

Received appropriation for 1879,	$200 00	
" " " 1880,	200 00	
		400 00
Balance expended from private means by Treasurer,		$431 99

I present herewith my statement of account of money received and expended. I found it necessary, in order to keep the machine in running order until help would come, to expend from my private means $431.99. I did this, having full faith in the appreciation, in due time, of the great importance of the work. Economy has been our perpetual care.

The County Boards have cost only the amount heretofore expended for the necessary medical services in the different counties, and the analyses of drinking water, food, &c., were done by the Agricultural Experiment Station. In every way the Board has demonstrated its fitness to live and be sustained at the hand of our State.

At the last meeting of the North Carolina Board of Health, upon the suggestion of the Secretary, it was resolved that steps be taken to secure the registration of vital statistics at the annual tax listing. The appended draft for a bill embodies the suggestion.

AN ACT TO ENSURE THE ANNUAL REGISTRATION OF VITAL STATISTICS.

The General Assembly of North Carolina do enact:

SECTION 1. It shall be the duty of each and every person annually, at the time when he or she or they shall list property for taxation, to to make out and sign and deliver to the township assessor, on a blank prepared and furnished as hereafter provided, a statement as follows, to-wit:

1st. Whether married, unmarried, widow or widower.

2nd. Number of births in the family within the year immediately preceding.

3rd. Number of deaths in the family within the same time, and the names of the diseases causing the deaths, as far as known.

4th. Whether any cases of the following diseases have occurred in the family for the year immediately preceding: Small-pox, scarlet fever, diphtheria, yellow fever, cholera.

SEC. 2. It shall be the duty of the State Board of Health annually to prepare and furnish to the commissioners of each county, at least thirty days before the time appointed by law for the listing of taxes, a sufficient number of blank forms, or lists, in which each tax-payer or lister shall make out the statement required by section 1 of this act, which said blanks shall be distributed by the commissioners aforesaid to the township assessors at least five days before the time appointed by law for the listing of taxes. The form of said blanks shall be prescribed by the Secretary of the State Board of Health, and may be accompanied by a circular from said officer giving instructions in regard to filling out the same and information desired.

SEC. 3. The blanks so made out and delivered to the assessors, as provided for in section 1 of this act, shall be forwarded by them to the clerk of the board of commissioners in each and every county at the same time required by law for the return of the abstract of the tax list to said clerk. And it shall be the duty of said clerk to forward at once all of said blanks so returned to him to the Secretary of State, who, after noting the same for record in his office, shall forward them to the Secretary of the State Board of Health.

SEC. 4. This act shall be in force from and after its ratification.

AN ACT SUPPLEMENTAL TO AN ACT CREATING A STATE BOARD OF HEALTH.

[Proposed amendments are printed in italics.]

The General Assembly of North Carolina do enact:

SECTION 1. That the Medical Society of North Carolina shall choose from its active members, by ballot, six members, and the Governor shall appoint three other persons, (one of whom shall be a civil engineer,) and these shall constitute the North Carolina Board of Health.

SEC. 2. That the North Carolina Board of Health shall take cognizance of the health interest of the citizens of the State; shall make sanitary investigations and enquiries in respect to the people, *employing experts when necessary*; the causes of diseases dangerous to the public health, especially epidemics; the sources of mortality; the effects of locations, employments and conditions upon public health. They shall gather such information upon all of these matters for distribution among the people, with the especial purpose of informing them about preventable diseases. They shall be the medical advisers of the State, and are herein specially provided for, and shall advise the government in regard to the location, sanitary construction and management of all public institutions, *upon application of the proper authorities*, and shall direct the attention of the State to such sanitary matters as in their judgment affect the industry, prosperity, health and lives of the citizens of the State. The Secretary of the Board shall make annually to the General Assembly, through the Governor, a report of their work for the year.

SEC. 3. The members of the Board of Health, as elected by the State Medical Society, shall be chosen to serve, two for six years, two for four years, two for two years. Those appointed by the Governor shall serve two years. In case of death or resignation, the Board will elect new members to fill the unexpired terms.

SEC. 4. The State Board shall have a President and Secretary, who shall be Treasurer, to be elected from the members comprising the Board. The President shall serve two years, and the Secretary and Treasurer six years. The Secretary and Treasurer shall receive *such compensation a year for his services as shall be fixed upon by the Board at its annual meeting*; but the other members of the Board shall receive no pay, except that while on actual duty at meetings of the Board, or on duty during the time special investigations are being pursued, each member shall receive \$2.00 a day and necessary travelling expenses. These sums shall be paid by the Treasurer on duly authenticated requisitions signed approved by the President of the Board.

SEC. 5. There shall be an Auxiliary Board of Health in each county in the State. These Boards shall be composed of the physicians eligible to membership in the State Medical Society, the mayor of county town, the chairman of the county commissioners, and the city surveyor, where there is such an officer, otherwise the county surveyor. From this number one physician shall be chosen by ballot to serve two years, with the title of Superintendent of Health. His duties shall be to gather vital statistics upon a plan designated by the State Board of Health. He shall make the medico-legal *post-mortem* examinations for coroners' inquests, and attend prisoners in jail, poor-house, and work-house. *He shall be the sanitary inspector of the jail and poor-house of his county monthly making reports to the Board of County Commissioners.* His report shall be made regularly as advised by the State Board through their Secretary, and they shall receive and carry out as far as practicable such work as may be directed by the State Board of Health.

SEC. 6. The salary of the County Superintendent of Health is to be paid out of the county treasury, upon requsition and proper voucher, as follows: *The salary of Superintendent of Health shall be such sum as the county commissioners shall deem just and proper for his services as physician to the public charitable and penal institutions of the county and as a health officer.*

SEC. 7. The organization of the North Carolina Board of Health shall be completed immediately after the passage of this act, and not later than six months after the passage of the same. The biennial meetings for the election of officers, shall, after the meeting of organization, be for the County Boards on the first day of January, and of State Board of Health on the first day of the annual meeting of the Medical Society of North Carolina.

SEC. 8. Monthly returns of vital statistics, upon a plan to be devised by the State Board of Health, shall be made by the County Superintendents, and a failure to report by the tenth of the month, for the preceding month, shall subject the delinquent superintendent to a fine of one dollar for each day of delinquency.

SEC. 9. Inland quarantine shall be under the control of the County Superintendent of Health, who, acting by the advice of the local Board, shall see that diseases dangerous to the public health, viz: small-pox, scarlet fever, yellow fever and cholera, shall be properly quarantined or isolated, (at the expense of the city or town in which it occurs). Any violation of the rules promulgated on this subject by the Superintendent of Health shall subject the offender to a fine of *twenty-five dollars* and imprisonment for not longer than twenty days in the county jail. In case the offender be stricken with disease for which he is quarantinable, he will be subject to the penalty on recovery, without, in the opinion of the Superintendent, it should be remitted. Quarantine of ports shall not be interfered with, but the officers of the local and State Boards shall render all aid in their power to quarantine officers in discharge of their duties upon request of the latter.

SEC. 10. ABATEMENT OF NUISANCES.—Wherever and whenever a nuisance upon premises shall exist, which in the opinion of the County Superintendent of Health is dangerous to the public health, it shall be his duty to notify the parties occupying the premises, (or the owner of the premises if not occupied), of its existence, its character, and the means of abating it, in writing. Upon this notification the parties shall proceed to abate the nuisance, but failing to do this shall be adjudged guilty of a misdemeanor and shall pay a fine of one dollar a day dating from twenty-four hours after the notification has been served: *Provided, however*, That if the party notified shall make oath or affirmation before a magistrate of his or her inability to carry out the directions of the superintendent, it shall be done at the expense of the town, city or county. In the latter case the limit of the expense chargeable upon the town, city or county shall not be more than one hundred dollars in any case.

SEC. 11. VACCINATION.—The Secretary of the State Board of Health shall keep a supply of fresh animal vaccine virus at his command, and he shall issue quantities, in value not to exceed one dollar for one requisition, to county superintendents in case of a threatened outbreak of small-pox. The county superintendents shall vaccinate and re-vaccinate all applying for such service, free of charge, the virus for such purpose being furnished by the Secretary of the State Board of Health. The county superintendent shall vaccinate every person admitted into a public institution, (jail, work-house, poor-house, public school), as soon as practicable, without he is satisfied upon examination that the person is already successfully vaccinated. On the appearance of a case of small-pox in a neighborhood, all due dilligence shall be used by the superintendent that warning shall be given, and all persons not able to pay, to be vaccinated free of charge by him. *Two hundred dollars are hereby annually appropriated for this purpose, to be accounted for by the Treasurer of the Board.*

SEC. 12. Bulletins of the outbreak of diseases dangerous to the public health shall be issued by the State Board whenever necessary, and such advice freely disseminated to prevent and check the invasion of disease into any part of the State. It shall also be the duty of the Board to enquire into any outbreak of disease, by personal visits or by any method the Board shall direct. The compensation of members on such duty shall be five dollars a day and the necessary traveling expenses.

SEC. 13. Special meetings of the State Board of Health may be called by the President, through the Secretary. The regular annual meetings shall be held at the same time and place of the State Medical Society at which time the Secretary shall submit his annual report.

SEC. 14. When the county Superintendent of Health shall in the course of his investigation required at coroner's inquest, think it necessary, to subserve the ends of justice, that a chemical analysis of the *viscera* or fluids of the body be made, he shall carefully pack up and seal the suspected article in a proper receptacle in the presence of a witness and forward it to the chemist of the agricultural station for analysis. Such analysis shall be made free of charge, and be returned to the coroner of the county, such analysis having precedence over other matters of investigation not of a similar character, then in the labratory of the chemist. Analyses for purposes connected with the hygenic duties of the Superintendent of Health shall in like manner be made by the said chemist, upon requisition sighed and approved by the Secretary of the State Board of Health. Such analyses will include soil, drinking water, articles of food, air, &c., to be packed for transmission by direction of the chemist of the agricultural station.

SEC. 15. For carrying out the provisions of this act *two thousand five hundred dollars are hereby annually appropriated*, to be paid on requisition signed by the Treasurer and President of the State Board of Health, and the printing and stationery necessary annually for the Board to be furnished on requisition. A yearly statement shall be made to the Legislature of all moneys received and expended in pursuance of this act.

SEC. 16. All previous acts conflicting with this are hereby repealed upon the passage of this act.

It is proper to state in this report the extent of the movement in sanitary matters in other States and by the general government. Up to the time of the great epidemic disaster in the Valley of Mississippi, in 1880, there had been organizations in several States, viz: in Massachusetts in 1869; in California, 1870; in Michigan and Louisiana in 1871, and in Minnesota and Virginia in 1872. But it was the great epidemic of yellow fever in 1878, which demonstrated to the people of this country the importance of organizations, by which to avert the invasion of epidemics as far as possible or disarm their virulency and afford relief to the suffering when once established. As if by one great impulse, cities and States, even those remote from the scene of the epidemic, sent their representatives to unite with the AMERICAN PUBLIC HEALTH ASSOCIATION, in their meeting in Richmond, Va., in 1878, an association already in vigorous work.

ing order, to initiate a new era of sanitary education and reform.

Prof. J. L. Cabell, M. D., says of this meeting: "It will be remembered by those who attended this meeting, that all its proceedings indicated a prevailing impression that the time had arrived for immediate and earnest efforts to secure effective sanitary legislation, both by separate States and by the general government. Numerous resolutions foreshadowing some such result as an event near at hand, were referred to the executive committee, who were to have the aid and counsel of a special advisory committee, composed of one member from each State represented in the Association, and a representative from each of the three branches of the National Medical Service, together with the Commissioner of Education." From the conference of these committees came forth a bill, which essentially became the National Board of Health law.

Since the time of this meeting nearly every State in the Union has a Board of Health in some stage of development, and all these States have representation in the American Public Health Association. This Association meets annually, discussing the great problems of sanitary progress, and educating the nation in the work to be done. At its last meeting, in December, 1880, in New Orleans, the Honorable Erastus Brooks, of New York, presented a paper on "*What the State owes the People.*" This paper was deemed of sufficient important to call forth a resolution, asking that the legislative bodies of the States be called especially. A copy of it is herewith transmitted. (Appendix E.)

The work of the North Carolina Board of Health has been then only a part, I fear a very small part, of the general sanitary movement in the United States. The field we found large enough to occupy all of our strength and time had there been means at our command to take advantage of our opportunities. We have shown our willingness to be pioneers in an undertaking which we deem essential to the future prosperity of our commonwealth. It now remains for this great State, so eager in the race for the supremacy among her sister States, to do her duty, and supply this Board with immediate and substantial means.

APPENDIX A.

METHOD FOR PERFORMING POST-MORTEM EXAMINATIONS.*

The following directions for medico-legal post-mortem examinations are prepared for the use of the County Superintendents, for the purpose of placing before them the latest and most approved plans for conducting such examinations, and to establish a uniform method throughout the State. The law makes it obligatory upon the County Superintendents (Section 5) to perform these examinations, and in order to make the monthly statistical returns of the greatest value, a careful observance of the following directions is desired by the State Board:

I.—General Directions.

1. The Medical Officers who are to perform the Examinations, and their Duties.—The examination of a dead body for medico-legal purposes is, in accordance with the existing law, to be undertaken by the County Superintendent of Health. The Superintendent performing the examination is charged with the duties of a medico-legal expert.

2. Time of Performance.—Autopsies should not, as a rule, take place until twenty-four hours after death; but the mere inspection of the dead body may be made earlier.

* Adapted from the German regulations of 1877, by Dr. Thomas F. Wood, Secretary of the North Carolina Board of Health. Translation from "*Medical* (London) *Examiner*."

3. Course to be adopted when the Corpse is in a state of Putrefaction.—The presence of putrefaction is not, as a general rule, a sufficient reason for omitting the examination, and does not justify the Superintendent in refusing to proceed with his duties. For even if putrefaction be very far advanced, any abnormalities and injuries of the bones can still be ascertained, and likewise many other circumstances, such as the color and state of the hair, the absence of limbs, &c., which may assist in establishing the identity in doubtful cases. Foreign substances within the body may also be discovered, as also the presence or absence of pregnancy and of poisons. When, therefore, the question arises of disinterring a dead body for the purpose of gaining information with reference to conditions of this kind, it is the duty of the physician to recommend the exhumation, regardless of the time that has elapsed since death took place.

4. Instruments.—The Superintendent should be provided with the following instruments, which are requisite for the performance of the examination: Four to six scalpels—two small, with a straight edge, and two large, with a curved edge; one razor; two strong cartilage knives; two pairs of forceps; two double hooks; two pairs of scissors—one pair large, having one blade with the point rounded off, the other sharp—the other pair small, one blade probe-pointed, the other sharp pointed; one pair of scissors for laying open intestines; one blow-pipe; one thick probe, and two fine ones; one saw; a mallet and chisel; a pair of bone forceps; six curved needles of various sizes; a pair of calliper compasses; a tape measure or other measure; pair of scales, with weights up to 10 lbs; a good magnifying glass; litmus and tumeric paper.

5. Place for the Examination and Light.—For the examination a sufficiently spacious and light room should be chosen, where the body can be placed in a suitable position, and in a quiet situation. It is not best to perform autopsies by artificial light, except in cases which admit of

no delay. In such a case the fact must be expressly alluded to in the notes, and mention made of the reason which rendered the performance at such a time imperative.

6. Bodies that are Frozen.—If the body is frozen, it is to be brought into a warm room, and the examination is not to be proceeded with until the parts are sufficiently thawed. The employment of warm water or other warm materials for expediting the thawing is not advisable.

7. Transport of Dead Bodies.—In moving the dead body in any way, and particularly in moving it from place to place, the greatest care must be taken to avoid applying any great pressure to any portion of it; and the large cavities should be kept as nearly as possible in a horizontal position.

II.—Proceedings at Post-Mortem Examinations.

8. The Judicial Objects of the Examination.—Those charged with making the examination should keep their attention fixed upon the judicial objects in view, and all things which are subservient to these objects must be investigated with minuteness and completeness.

Anything that appears important must be noted down in a minute book, which will be provided on application to the Secretary of the Board.

9. Duties of those charged with the Examination with reference to the ascertaining of Peculiar Circumstances connected with the Case.—It is the duty of those charged with the examination, in cases where it appears to them to be requisite, before the examination is commenced, to request the magistrate for permission to inspect the place where the body was found, and ascertain the position which it occupied, and also to examine the clothes which were found on the deceased.

10. Chemical Examination.—In all cases in which a chemical examination is necessary, the directions issued by

the Chemist of the Board (Prof. Ledoux, Chapel Hill,*) should be strictly followed.

11. THE EXAMINATION OF THE BODY.—The examination of the dead body consists of two principal parts:—

A. The external examination (inspection).

B. The internal examination (the dissection).

12. EXTERNAL EXAMINATION.—The external examination includes that of the external surface of the body in general and of its separate portions.

With reference to the condition of the body generally, the following are the points to be noticed:—

1. Age; sex; size; bodily conformation; general state of nutrition; any signs of disease, such as ulcers about the legs, peculiar abnormalities, as spots, cicatrices, marks of tattooing, excess or deficiency of limbs.
2. The signs of death and of any decomposition which may be present.

Should the body be soiled with blood, fæces, dirt and the like, these must be washed off, and it must then be ascertained whether rigor mortis is present or not; the color of the skin generally must be noticed, and the kind and degree of any coloration or discoloration due to decomposition that may be present in any part, also the color, position and extent of the post-mortem stains, which must be cut into and examined carefully, in order to discriminate between such appearances and those due to extravasations of blood.

With reference to individual portions of the body, the following points must be attended to:—

1. When the body is that of a person unknown, the color, and other peculiarities of the hair (of the head and the beard), and likewise the color of the eyes are to be noted.

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* See note

2. The presence of any foreign substances in the natural apertures of the body, the state of the teeth, and the condition and position of the tongue.
3. Then are to be examined the neck, the chest, the abdomen, the back, the anus, the external organs of generation, and lastly, the limbs.

Should there be an injury on any portion of the body, a description must be given of the shape, position and direction, with reference to fixed points; also its length and breadth in actual measurement. In this external examination, any probing of wounds and injuries is, as a general rule, to be avoided, inasmuch as the depth can be readily ascertained during the internal examination of the body and of the injured parts. If those performing the autopsy deem it necessary to introduce a probe, they must do this very carefully, and state their reasons for so doing in the notes of the proceedings.

When wounds have been discovered, the condition of their borders and surrounding parts is to be determined, and after the examination and description of the wound in its original state, it should be enlarged in order to ascertain the internal condition of its borders and base.

When the body presents wounds and injuries which have clearly nothing to do with the cause of death—for example, marks made in attempts at rescue, bites of animals and the like—it is sufficient that such appearances should be summarily noted.

13. Internal Examination—General Directions.—In the internal examination, the three principal cavities of the body, viz., the head, the thorax and the abdomen are to be opened.

The opening of the vertebral canal, or of separate joints, is never to be omitted in cases in which any information may be expected from such examination.

When there is any definite suspicion with regard to the cause of death, that cavity is first to be opened in which the principal changes are supposed to exist; but in other cases, the head is to be opened first, then the thorax, and lastly the abdomen.*

In each of these cavities, the first thing to be done is to determine the position of the organs therein contained; then the color and condition of their surfaces, the presence or absence of any unnatural contents, especially of foreign bodies, gases, fluids, or coagula; and with regard to the last two substances, their size and weight should be determined. Each separate orgon is finally to be examined both exter- and internally.

14. The Cavity of the Skull.—Unless there are any injuries which have to be avoided by the knife, and which would necessitate some other method of procedure, the head is to be opened by means of an incision carried across the middle of the skull from one ear to the other, the soft parts covering the head are then to be reflected backwards and forwards.

Attention having been paid to the condition of the soft parts and of the surface of the bones, these latter are to be sawn through in a circular manner and the skull-cap is to be removed. The cut surface, the internal surface, and the general condition of the cranial arch are to be minutely investigated.

In the next place the external surface of the dura mater is to be examined, the superior longitudinal sinus opened and its contents determined; the dura mater is then to be divided on one side and turned back and its inner surface examined, as also the condition of the exposed portion of pia mater.

After this has been done on the other side, the brain is to be carefully removed and the base of the skull is to be examined for any unusual contents. Attention must be paid to the condition of the dura and pia mater at the base and side of the skull, and to that of the large arteries.

* With regard to new-born children see paragraphs 22 and 23.

The transverse sinuses are next to be opened and also the other sinuses (if there is any cause for so doing) and their contents are to be determined. The size and shape of the brain are next to be ascertained, and the color, the fullness of the vessels, and the consistence and structure of the organ are to be determined by means of a series of incisions through individual portions, viz., the hemispheres of the cerebrum, the great ganglia (the optic thalamus and corpus striatum), the corpora quadragemina, the cerebellum, the pons varolii, and the medulla oblongata.

In addition to this, attention must always be paid to the condition of the tissue and vessels of the Velum interpositum and choroid plexus.

The extent and contents of the different ventricles, and likewise the condition and amount of fulness of the various venus plexuses are to be carefully demonstrated, and the presence or absence of any coagular external to the vessels is to be determined.

Finally, the bones of the base and lateral portions of the skull are to be examined, for which purpose the dura mater must be previously removed.

15. The Face, Parotid Gland and Ear.—When it is necessary to lay bare the internal parts of the face and to examine the parotid gland or the ear, the incision carried over the head is to be prolonged behind the ears to the neck, and the skin is to be dissected forward, in order to spare it as much as possible. Particular attention is to be paid to the condition of the large arteries and veins.

16. The Vertebral Column and the Spinal Cord.—The vertebral column is, as a rule, to be opened from the posterior aspect. The skin and the subcutaneous fat are first to be divided exactly over the spinous processes; the muscles are then to be removed from the sides of these latter and from the arches of the vertebræ. Extravasations of blood, lacerations and other injuries, particularly fractures of the bones, are carefully to be looked for.

Then a chisel is to be taken, or a vertebral saw, if at hand, and the spinuos processes, together with the adjoining portions of the vertebral arches, are to be detached and removed. The dura mater is now exposed, and after its external surface has been examined, it is to be carefully slit open longitudinally and the presence of any serum. or extravasated blood or other abnormal matters is to be determined. The color, the appearance and general condition of the posterior portion of the pia mater are next to be noticed, and the resistance to pressure of the spinal cord is to be ascertained by gently passing the finger over it.

The roots of the nerves are next to be divided on both sides by a longitudinal incision; the lower end of the cord is to be carefully taken out, its anterior connections are next to be gradually separated and finally the superior extremity is to be removed from the occipital foramen.

In carrying out these directions, great care must be taken that the spinal cord be neither pressed nor bent. When removed, the condition of the pia mater on the anterior aspect is first to be examined, then the size and color (external) of the spinal cord are to be noted, and lastly numerous transverse incisions are to be made with a very sharp and thin knife, to determine the internal condition of the spinal cord, both of its white strands and of the gray substance. Lastly, the dura mater is to be removed from the bodies of the vertebræ, and the dissector is to examine for effusions of blood, or injuries or alterations in the bones or intervertebral cartilages.

TABULAR PLAN OF PARTS OPPOSITE THE SPINES OF THE VERTEBRA.*

Cervical.	7th.	Apex of the lung: higher in the female than in the male.
Dorsal Spines.	1st.	
	2nd.	
	3rd.	Aorta reaches spine. Apex of lower lobe of lung. Angle of bifurcation of trachea.
	4th.	Aortic arch ends. Upper level of heart.
	5th.	
	6th.	
	7th.	
	8th.	Lower level of heart. Central tendon of diaphragm.
	9th.	Œsophagus and vena cava through diaphragm. Upper edge of spleen.
	10th.	Lower edge of lung. Liver comes to surface posteriorly. Cardiac orifice of stomach.
	11th.	Lower border of spleen. Renal capsule.
	12th.	Lowest part of pleura. Aorta through diaphagm. Pylorus.
Lumbar.	1st.	Renal arteries. Pelvis of kidney.
	2nd.	Termination of spinal cord. Pancreas. Duodenum just below. Receptaclum chyli.
	3rd.	Umbilicus. Lower border of the kidney.
	4th.	Division of aorta. Highest part of ilium.
	5th.	

17. Neck, Thorax, and Abdomen.—Genernl Directions.—In opening the neck, thorax and abdomen, it is generally sufficient to make one long incision from the chin to the pubes, passing to the left of the umbilicus. In ordinary cases, the incision is to be carried right into the ab-

* Holden's Landmarks, Amer. Ed., p. 51.

dominal cavity, care being taken not to injure any of the contents. The best plan is to make at first a very small incision into the peritoneum. Notice must be taken whether any gas or fluid escapes. First one and then a second finger is introduced, the integuments are raised from the contents, and the further incision through the peritoneum is to be made between the two fingers.

Notice must then be taken of the position, color, and appearance in other respects of the exposed viscera, and of any foreign contents that may be present, and the position of diaphragm is to be determined by examination with the hand.

The examination of the abdominal organs is not to be continued at this stage unless there be particular reasons for believing that the cause of death will be found in the abdominal cavity (Section 13). As a general rule, the examination of the thorax must precede the further examination of the abdomen.

18. The Thorax.—For opening the thorax it is necessary that the soft part of the chest should first be dissected back beyond the points of attachment of the cartilages to the ribs. The cartilages are then to be divided with a strong knife about a third of an inch internal to their attachments. Care must be taken to avoid injuring the lung or the heart. When the cartileges are ossified, the best plan is to divide the ribs with a saw or bone-forceps a little external to the attachments of the cartileges. The clavicles are then to be separated from the manubrium of the sternum by means of a crescentic incision, the knife being held vertically, and the junction with the first rib, whether cartilaginous or bony, is to be divided with the knife or bone-forceps, the greatest care being taken to avoid injuring the vessels lying beneath. Then the attachments of the diaphragm, between the ends of the two incisions, are to be divided close to the cartileges of the false ribs and the ensiform cartilege, the sternum is to be turned upwards, and the mediastinum cut through,

care being taken to avoid injuring the pericardium and large vessels.

After removing the sternum, the condition of the pleural cavities is to be determined; the presence, condition, and quantity of any abnormal contents, the state of distention and the general appearance of the exposed portions of lung are to be noticed. If, in the removal of the sternum, any vessel has been injured, this must be tied, or a piece of sponge must be applied to it to prevent the blood from escaping into the pleural sac, where its presence might give rise to mistakes. The condition of the mediastinum, the state of the thymus gland, and likewise the condition of the large vessels outside the pericardium (which vessels, however, are not yet to be opened) are now to be noticed.

Then the pericardium is to be opened, and its condition noticed and the heart examined. With regard to the latter, its size, the fulness of the coronary vessels and of its separate cavities (auricles and ventricles,) its color and consistence (post-mortem rigidity) are all to be noticed before any incision is made and before the heart is removed from the body. Then, while the heart is still unsevered from its natural connections, each ventricle and each auricle are to be separately opened and the contents of each cavity are to be determined with regard to their quantity, state of coagulation and general appearance, and the size of the auriculo-ventricular valves is to be tested by introducing two fingers from the auricle. Then the heart is to be removed; the condition of the arterial openings is first to be tested by pouring in water, and then, after an incision has been made, the condition of the muscular tissue of the heart is to be noticed with reference to its color and general appearance. If there be reason to suppose that the muscular structure has undergone considerable alteration—fatty degeneration, for example—a microscopical examination must always be made.

The examination of the heart is to be followed by that of the large vessels, but the descending aorta is to be left until the lungs have been examined. In order to examine the lungs minutely, they must be removed from the thoracic cavity. Their removal must be effected with great care, and the lung-tissue must not be torn or squeezed. If extensive adhesions exist, and particularly if they are old-standing, they must not be divided, but a portion of the costal pleura should be removed with the attached adhesions. After removal of the lungs, their surface is to be again carefully examined, in order that recent changes—for example, the commencement of inflammatory exudation—may not be overlooked. The capacity for air, the color, and the consistence of each portion of the lungs, are to be noticed; finally, large smooth incisions are to be made, and the following points attended to: the state of the cut surfaces; the amount of air, blood, and serum; the presence of any solid contents in the pulmonary vesicles; the condition of the bronchial tubes and pulmonary artery, with especial reference to obstruction, &c., in the latter. For this purpose the air-passages and the large branches of the pulmonary artery are to be divided with the scissors, and followed out to their finer ramifications.

In cases where it is suspected that foreign matters have entered the air-passages, and where substances, the nature of which is not evident on simple inspection, are found in the air-tubes, recourse should be had to the microscope to determine their nature.

19. The Neck.—According as circumstances may require, the neck may be examined either before or after the opening of the thorax or the removal of the lungs. Those performing the autopsy, may, if they think fit, make a special examination of the larynx and air tubes, if such investigation be of particular importance, as, for instance, in cases of death from strangulation or drowning.

As a general rule, the best plan is first to examine the large vessels and the nerve-trunks, and afterwards to open the larynx and trachea by an incision carried along their anterior aspect, and to examine their contents. In cases where it is especially important to examine these parts, they should be looked to before the lungs are removed from the body, and pressure should be carefully made upon these latter organs in order to see whether any liquid matters, &c., ascend into the trachea.

The larynx is then to be removed, together with the tongue, the soft palate, the pharynx, and the œsophagus; each of these parts is to be incised, and its condition ascertained, the state of the mucous membrane being particularly noticed. The thyroid gland, the tonsils, the salivary glands, the cervical lymphatic glands, are all to be examined.

In cases where the larynx or trachea has been injured, or where important changes are supposed to exist in these parts, an incision is not to be made into them until they have been removed from the body, and they are then to be opened from their pesterior aspect.

Where death has resulted from strangulation, or presumably from suffocation, and the carotid arteries are opened in order to ascertain whether there is any injury of the lining membrane, the vessels should be examined while still in their natural position.

Finally, the state of the cervical vertebræ and of the deep muscles of the neck should be noticed.

20. The Abdomen.—In the further examination of the abdominal cavity and of its contents, a certain order of sequence is always to be adopted, so that the removal of an organ shall not interfere with the minute investigation of its relations to other parts. Thus the duodenum and biliary ducts should be examined before the removal of the liver. As a general rule, the following order of sequence is advisable:—The omentum. 2. The spleen. 3. The kidneys and suprarenal capsules. 4. The urinary bladder. 5. The

organs of generation (in the male subject, the prostate gland and vesiculæ seminales, the testicles, the penis, with the urethra; in the female, the ovaries, Fallopian tubes, uterus, and vagina). 6. The rectum. 7. The duodenum and stomach. 8. The gall duct. 9. The liver. 10. The pancreas. 11. The mesentery. 12. The small intestine. 13. The large intestine. 14. The large blood vessels in front of the vertebral column, their contents to be examined and determined.

THE SPLEEN.—The length, breadth, and thickness of the spleen are to be ascertained while the organ is lying free and not when placed in the hand, and the spleen is not to be compressed by the measure. A longitudinal incision is then to be made, and if any alterations of structure are manifest the organ should be incised in various directions. The quantity of blood is always to be noticed.

THE KIDNEYS.—Each kidney is to be removed by a vertical incision through the peritoneum, external to and behind the ascending or descending colon, the intestine is to be pushed aside, and the kidney detached from its connections. The capsule is then to be carefully removed, a long incision being made into it over the convex border of the kidney. The surface thus exposed is to be noticed with reference to the size, shape, color, quantity of blood contained, and any morbid appearance that may be present. A long incision is then to be made through the kidney, as far as its pelvis, the cut surface is to be washed with water, and described with reference to the condition of the cortical and medullary substance, vessels, and parenchyma.

THE PELVIC ORGANS.—The organs of the pelvis (the bladder, the rectum, and the generative organs therewith connected) are best removed together, but the bladder should first be opened *in situ*, and its contents determined. Then the parts should be further examined, the generative organs being taken last. The vagina should be opened and examined before the uterus. In examining the body of a woman who has died after delivery, special attention should be paid to the condition of the veins and lymphatics, both in the inner surface of the uterus and in its walls and appendages, the size and contents of the vessels being especially noted.

THE STOMACH AND DUODENUM.—The condition externally of the stomach and duodenum is first to be ascertained while the parts are *in situ*. Then, with a pair of scissors, the duodenum is to be slit up on its anterior aspect, and the stomach along the great curvature; the contents are then to be examined, the permeability of the gall duct and any matter contained therein are also to be noticed, and then the parts are to be removed for further examination.

THE LIVER.—The external appearance of the liver is first to be described, and the organ is to be removed after the examination of the excretory ducts. Long, smooth incisions are then to be carried transversely through the organ, and the amount of blood and general condition of the parenchyma are to be ascertained. The description is to contain a short account of the general condition of the lobules, the appearance of their centres and circumference being particularly noticed.

SMALL AND LARGE INTESTINES.—The small and large intestines are to be examined with reference to a degree of distension, color, and other external appearances; they are then to be removed together, the mesentery being cut through close to the intestines. After removal, the intestine is to be slit up with the scissors along the line of the attachment of the mesentery. As this is being done, the contents of each portion are to be noticed and estimated. Then the intestine is to be well cleansed with water, and the condition of the various portions noticed, particular attention being paid to the agminate and solitary glands, the villi, and valvulæ conniventes of the small intestine. In every case of peritoneal inflammation, examine carefully the vermiform appendage.

21. CASES OF POISONING.—In cases where poisoning is suspected, the abdominal cavity is to be first examined.

Before anything further is done, attention is to be paid to the external appearance of the principal viscera, their position and size, the fullness of their vessels, and also as to whether there be any odor perceptible.

With regard to the vessels, the points here to be determined, as in other important organs, are as follows: Are the vessels arteries or veins? Does the congestion prevail in the finer ramifications, or only in the trunk and branches of a certain size? Are the intervascular spaces of considerable extent or not?

Double ligatures are then to be placed around the terminal portion of the œsophagus, just above the cardiac orifice, and two more around the duodenum, below the opening of the gall duct. The parts are to be divided between the ligatures. The stomach is then to be removed with the duodenum, care being taken to avoid injuring the parts. They are then to be opened as described in Section 20.

The contents are to be examined with regard to the quantity, consistence, color, composition, reaction and smell, and placed in a clean porcelain or glass vessel, following the directions of the Chemist of the Board of Health.

The mucous membrane is then to be washed with water, and its color, thickness, surface and consistence are to be noticed. Particular attention is to be paid to the state of the blood vessels, and to the tissue of the mucous membrane generally, and of each of the principal portions of the stomach. Care should be taken to ascertain particularly whether any blood that may be present is within the vessels or extravasated, also whether it is recent or altered by putrefaction or digestion, and under these circumstances has penetrated by imbibition into the parts around. If extravasated, its situation should be determined—whether on the surface or in the tissue, and whether coagulated or not.

The surface of the mucous membrane is to be carefully examined for any breaches of continuity, such as loss of substance, erosions, or ulcers. The question as to whether the alterations manifested may have occurred after death, from natural decomposition, or from the action of the fermenting contents of the stomach, is to be carefully kept in mind.

This examination having been completed, the stomach and duodenum are to be placed in the vessel which contains the contents (see above,) and delivered to the Chemist of the Board, for further investigation. The œsophagus having been tied in the neck and divided above the ligature, and subjected to examination, is also to be placed in the same vessel. In a case where the stomach contains but very little the contents of the jejunum should be retained in like manner.

Lastly, other materials and portions of organs, such as blood, urine, pieces of liver, kidneys, &c., are to be taken from the body separately for further examination. The urine is to be placed in a separate vessel. The blood is to be kept separately only in cases where a definite conclusion may be anticipated from spectrum-analysis.

Portions of organs reserved are to be placed together in one vessel.

Each vessel is to be carefully closed, sealed, and marked.

If on simple inspection, the gastric mucous membrane appears particularly opaque and swollen, no time should be lost in examining it with a microscope, especial attention being paid to the condition of the peptic glands.

The microscope is also to be used in cases where the stomach contains any suspicious substances, such as portions of leaves or other vegetable matters, the remains of animal substances taken as food, &c.

Where trichiniasis is suspected, the contents of the stomach and upper part of the jejenum are first to be subjected to microscopical examination, but portions of the muscular tissue (of the diaphragm, cervical and pectoral muscles) are to be put aside for further investigation.

22. New born Children: Determination of Maturity and Period of Development.—In the post-mortem examination of new-born children special attention is to be directed to the following points in addition to the above-mentioned general rules:

In the first place, the signs indicative of maturity and period of development must be ascertained.

These are—the length and weight of the child, the condition of the general integuments and of the umbilical cord, the length and state of the hair of the head, the size of the fontanelles, the diameter of the cranium (longitudinal, transverse, and diagonal,) the condition of the eyes (membrana pupillaris,) the state of the cartilages of the nose and ear, the length and condition of the nails, the transverse diameter of the body at the shoulders and hips; in male infants, the condition of the scrotum and position of the testicles; in females, the condition of the external organs of generation. Finally, we must examine the size of the centre of ossification (if present) in the inferior epiphysis of the femur. For this purpose, the knee-joint must be opened by means of a transverse incision below the patella, the joint fully bent and the patella removed; thin layers are then to be cut from the cartilaginous end of the femur, till the greatest transverse diameter of the centre of ossification (if present) be reached; this is to be measured.

Should the condition of the fœtus be such as clearly to prove that it was born before the completion of the thirtieth week, it is not necessary to proceed further with the examination.

23. Determination of the Question whether the Child has Breathed.—If it shall appear that the child has been born after the thirtieth week, we must in the next place ascertain whether it has breathed during or after birth. For this purpose the respiration test must be applied, and the proceedings conducted in the following order—:

(*a*). Immediately on opening the abdominal cavity the position of the diaphram is to be ascertained with reference to the corresponding rib, and on this account in new-born children the abdomen is always to be opened first, and afterwards the thorax and cranium.*

(*b*). Before opening the thorax a ligature is to be placed around the trachea above the sternum.

(*c*). The thorax is then to be opened, and attention must be paid to the amount of dilatation of the lungs and their position dependent upon such dilatation, particularly with reference to the pericardium. The color and consistence of the lungs should also be ascertained.

(*d*). The pericardium is then to be opened, and its condition and that of the heart externally are to be ascertained.

(*e*). The cavities of the heart are then to be opened, and their contents to be examined, and the condition of the heart in other respects is to be determined.

(*f*). The larynx and the portion of the trachea above the ligature are then to be opened by means of a longitudinal incision, the condition of their walls is to be ascertained, and any contents are to be examined.

(*g*). The trachea is to be divided above the ligature and removed, together with all the organs of the thorax.

(*h*). After removing the thymus gland and the heart, the lungs are to be placed in a capacious vessel filled with clean cold water, in order to test their buoyancy.

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*The dissection, however, of the abdominal organ is never to precede the opening and examination of the thorax.

(*i*). The lower part of the trachea and its sub-divisions are to be laid open and examined, especially with reference to their contents.

(*k*). Incisions are to be made in both lungs, and notice taken whether any crepitating sound be heard, and also with reference to the amount and quality of the blood issuing from these cut surfaces on slight pressure.

(*l*). Incisions are to be made into the lungs below the surface of the water, in order to see whether any air-bubbles rise from the cut surfaces.

(*m*). Both lungs are next to be separated into their lobes and these are to be divided into several small pieces, and the buoyancy of each of these portions is to be tested.

(*n*). The œsophagus is to be opened and its condition ascertained.

(*o*). Lastly, in cases where it is suspected that air cannot gain access to the lungs in consequence of the filling up of their cells and pessages with morbid products (hepatization) or foreign substances (mucus, meconium), the lung-tissue is to be examined with the microscope.

24. Other Examinations.—In the last place it is the duty of those performing the examination to examine all other organs or parts not mentioned by name in the regulations, in any case in which the parts in question are found to be injured or otherwise abnormal.

25. End of the Examination—The Cavities to be closed.—The examination being cempleted and the body cleansed as far as possible, it is the duty of the Superintendent to close up carefully those cavities of the body which have been opened.

III.—Making the Report of the Examination.

26. The Report of the Examination.—A report of everything connected with the post-mortem examination should be made out at once on the blanks furnished, adding additional remarks on the back if necessary.

27. Arrangement and Drawing up of the Report.—The technical portion of the report of the autopsy must be made out by the Superintendent of Health; it must be clear, definite and intelligible.

The appearances found must be accurately described as matters of fact and not in the form of mere opinions (*e. g.*, "inflamed," "gangrenous," "healthy," "normal," a "wound," an "ulcer," and the like.) But the Superintendents may, if they please, for the sake of distinctness, add to the statement expressions in parentheses to indicate what they have actually observed.

In every case a statement must be given with regard to the quantity of blood in each important part, and what is required in a terse description, and not merely an opinion expressed in such terms as "intensely," "moderately," "somewhat," or "very reddened," "full of blood," "bloodless." In the description, the size, shape, color, and consistence of the various parts are to be observed and noted before making any incisions.

28. Opinion.—At the conclusion of the autopsy, if any particular facts influencing his opinion have come to his knowledge, whether from the proceedings or otherwise, these should be briefly mentioned.

If the cause of death has not been discovered, the fact must be expressly mentioned. It is never sufficient to say that the death has resulted from internal cause or from disease; the disease must be specified.

In cases where further technical examination is necessary, or where there are any doubtful circumstances, it is better for the Superintendent to postpone his opinion until more minute examination is made.

29. Supplemental Explanation with regard to Weapons.—If there be any injuries on the dead body which may have been the cause of death, and if it be suspected that a weapon that has been discovered has been used to cause the injuries, then the Superintendent of Health must institute a comparison between them, and must state whether and what injuries could have been caused by the weapon, and whether any conclusions can be drawn from the position and condition of the injury as to the mode in which the perpetrator has acted, and as to the force used.

Should weapons not be forthcoming, the Superintendents should express an opinion, as far as the appearances will permit, with regard to the way in which the injuries may have originated, and with reference to the nature of the weapons employed.

The report of the examination is to be signed by the Superintendent of Health, and if another physician has assisted at the autopsy, it should be stated.

Note.—*Virchow's directions as to how incisions should be made.*—It may serve as a useful hint, even to those quite familiar with old time methods, to quote from Prof. Virchow's "*Method of performing post-mortem examinations.*" "For all ordinary purposes of pathological dissection, I now grasp the handle of the knife in the palm of my hand, so that when I stretch out my arm the blade appears as a direct prolongation. I fix then relatively, if not absolutely, the joints of the fingers and hand, and make the cutting movements with the entire arm, so that the principal movements occur in the shoulder-joints, the secondary ones in the elbow. In this way I am able to make long and useful incisions, and smooth ones as well, for I can utilize the whole force of the arm, and especially of the muscles about the shoulder; and it is only on surfaces produced by such incisions as these that we are able to see anything really satisfactory." English Edition, p. 25.

" * * A good pathological anatomist is perfectly able to dissect all the viscera of one subject, or even of two, with one knife; a pathological 'layman,' holding his knife as he would a pen, requires three or four knives for one autopsy." p. 26.

"I maintain that a free incision, even when wrongly done, is, as a rule, to be preferred to a small though accurate one, and is almost always better than several or many small cuts. The large even cut is peculiarly the one for demonstration purposes. To make it, I look carefully at each separate organ, to find where I can get the largest surface on section. I therefore cut through a spleen from above downwards, over the middle of its outer (convex) surfarce, a kidney from without and within (from the external to the internal border), a liver from right to left in a horizontal direction; the testicle I cut into two equal parts in a perpendicular direction from its free to its attached border, and snap the parts asunder. I divide each lobe of the lung by a perpendicular incision directed from above downwards, and from its thicker border towards the inner (anterior, medial, sharp) one. Each hemisphere of the cerebellum I divide by an incision which commences in the fourth ventricle, in the direction of the crus cerebelli, and is carried obliquely outwards."

METHOD OF PROCEDURE IN CASES OF SUSPECTED POISONING.

LABORATORY OF THE N. C. EXPERIMENT STATION,
CHAPEL HILL, April 24th, 1878.

To the Coroners and County Superintendents of Health of the State of North Carolina:

I beg to call attention to section 14 of "An Act Supplemental to an Act creating a State Board of Health," passed by the late Assembly and ratified on March 14th. This section is as follows:

"SEC. 14. When the County Superintendent of Health shall, in the course of his investigation required at coroner's inquest, think it necessary to subserve the ends of justice that a chemical analysis of the *viscera* or fluids of the body be made, he shall carefully pack up and seal the suspected article in a proper receptacle, in the presence of a witness, and forward it to the chemist of the agricultural station for analysis. (Such analysis shall be made free of charge, and be returned to the coroner of the county, such analysis having precedence over other matters of investigation not of a similar character then in the laboratory of the chemist.)"

*   *   *   *   *   *   *

The Board of Agriculture, recognizing not only the claims of the law but the claims of humanity upon them, have made arrangements by which the analyses in question can be made through the Experiment Station. Knowing that were I compelled to make such analysis in person it would occasion great delay and serious interference with my work, especially during my long absences from my post when testifying at court, &c., they adopted the following resolution:

"*Resolved,* That the Chemist of the Board be authorized to employ such additional labor as may be necessary to prosecute the analyses in cases of suspected poisoning, as required by section 14 of an act supplemental to an act creating a State Board of Health, at an expense for the same of not more than............dollars per annum."

In compliance with the above resolution of the Board, I have secured the co-operation of Prof. A. F. Redd, of the University, who will devote himself to any cases which may arise under the provisions of the law above cited. Prof. Redd has made all the analyses of this character that have been required in the State during the last two years, so far as I am informed. Your attention is called to the following instructions, which should be followed as nearly as possible to comply with the law and to secure an analysis which will stand in court:

1st. Except in special cases, it will be sufficient to place the stomach, the whole of the liver and spleen and the bladder each in a separate, perfectly clean glass jar, with tightly fitting glass top (a fruit jar serves well). Care should be taken that none of the contents of the stomach or bladder escape. No disinfectant or preservative should be added in any case.

2d. Seal each jar thoroughly and label distinctly with the name of its contents.

3d. Secure, if possible, any vomit or urine voided immediately before death, and also any liquids, powders or other substances which are suspected of having caused death, or any vials or other receptacles which may have contained the poison, sealing each as before.

4th. Let these jars be delivered at the station by some one, properly authorized, in person. Do not send by express. The person bringing the jars should never allow them (or the receptacle in which they may be packed), to get out of his sight, unless to go under a lock, to which the carrier holds the key. The messenger will bring the jars to the Experiment Station and deliver them to me, or to Prof. Redd in my presence.

The expense of these analyses will be defrayed by the Department of Agriculture, but the pay of Prof. Redd in attendance upon court will still be regulated by the laws specially providing for the remuneration of witnesses and experts.

Respectfully,

ALBERT R. LEDOUX,

Chemist to the Department of Agriculture.

Appendix B.

CIRCULAR ON VENTILATION, DRAINAGE, DRINKING WATER AND DISINFECTANTS.

The months of August, September and October being the season of the greatest rain-fall attention is called to the condition of cellars, drains, ditches, and wells. While it has not been settled that soil-soakage is the cause of diphtheria, or typhoidal diseases, it has been the experience in some of the sea-coast towns, that the greatest prevalence of diphtheria has been at this period. It is at this season that the malignant and simpler forms of malarial fever abound in alluvial tide water districts; that the cellars of houses are more apt to become harmful; that the water in wells oftener becomes contaminated by the rapid percolation of the soil by rain-water.

The fruits ripening at this season, too, have been thought to be the cause of disease, so that some persons avoid scuppernong grapes and melons, thinking that this is the secret of their escape from fever. Mullet and other fish have also the reputation of causing fever. It is hardly necessary to say it, but we repeat what many physicians say daily in their professional rounds, that fruit and fish in good condition are safe articles for those with whose digestion they ordinarily agree.

Ventilation.—Ventilation of the cellars of houses by freely opening the doors and windows, cleansing and whitewashing, and sprinkling unslacked lime in the moist places, is a prime necessity to keep the air of the house pure. The drainage of the soil adjacent should be looked after, and especially should all waste pipes and sewer pipes be inspected with care.

A house imperfectly supplied with large enough windows and doors is not easy to remedy. But in most of our houses, the old fashioned broad fire place still has ascendency, furnishing a means of ventilation of a superior character. Now if care is taken that in the occupied rooms a little fire is built morning and night, a free circulation of air is effected, and the air of these rooms is made pure. This precaution has long been observed in the tide-water regions of this State. Even in the warmest days the hearth is made cheerful at night by the ruddy glow of the lightwood fire. The chief obstacles to ventilation in the average houses being too low ceilings and too small windows.

Where the simple construction we have mentioned does not prevail, and by mistaken economy stoves and grates have taken the place of the open fire place, ventilation should be remedied by the means mentioned in Mr. William Cain's paper on Ventilation, issued by this Board.

Ditches.—It is a question that should be settled with thougtful deliberation, to what extent ditches should be opened in August and September, or indeed before the occurrence of frost. Nearly all Southern cities have adopted the rule of forbidding the disturbance of the soil to lay gas pipes, digging out foundations for building, and opening ditches between certain months, say from June until November. This is a good rule and should be adhered to most rigidly in sea-coast towns, especially where there has ever been an epedmic of yellow fever. So much stress, too, was laid upon this matter by the rice planters on the Cape Fear river before the war, that the negroes were not allowed to dig out the ditches in August after the crop was "laid by," and while the weather was hot, as less sickness was known to result from the same work in winter.

It is safe to say though, that ditches draining the site upon which dwellings stand, should be opened even in August, if the necessities of the case demand, or the proprietor has neglected it in its proper time. It is far more prudent to turn up the soil than to have the surface water wash into the well, or that standing ponds, or constantly wet places should go unremedied. In cities, though, we would advise against this course. If the needed work has been neglected, the extent of work done should be limited to opening drains and ditches which have been plugged up by floating debris, or by caving; and for the more urgent reason of saving property from destruction, such as the undermining of the foundation of buildings and conduits.

Wells and Drinking Water.—Wells are so universally used that many cautions are necessary for their maintenance in such a condition as to be pure sources of water. The picture constantly before the eyes of the watchful sanitarian is that of a well dug in porus soil, a few feet from the privy, and cow shed, and house; dug deeper than the uncemented vault of the privy, and serving as a drain into which impure water gravitates. Sometimes these views are looked upon as existing mainly in the imagination of the officers of the health department; "for," says the doubter, "we have been drinking this water, and our neighbors come from distances to get it because it is cool and pure." Nevertheless, even in such cases, where the owner may have the utmost confidence that his well water needs no improvement, it is foul with the impurities which his perverted and blunted taste no longer detects.

One noteworthy instance among many others which have come to light since this Board commenced the analysis of drinking water was that of the well of a gentleman living in Wilmington. On a high sandy ridge his well had been dug many years ago. His neighbor to the east of him had an uncemented privy vault 20 feet off. His own privy was not twice the distance. The family, consisting of seven or eight, did not enjoy as good health as their neighbors. The doctor's phæton was often at the door. The gentleman believing something to be wrong in the surroundings of his residence, caused all the undergrowth to be cut out. His house, which was a wooden structure, raised from the ground on brick pillars, was ventilated underneath, and lime sprinkled freely to dry up and purify the moist soil. The ventilation of the rooms was improved; articles of diet were carefully looked after, but no adequate improvement followed.

He was advised by the Board of Health to have his drinking water analyzed. This was done by the chemist of tho Board, revealing shocking impurities from the suspected sources. The well water was abandoned for drinking and cooking purposes.

A sanitary map of the city of Wilmington, for which material is being collected, shows the depressions in the soil, where, in the rainy days of fall, the water ponds, sometimes for weeks. One particular locality, bounded by McCumber's alley on the N. W., Ninth street on the E., and Chestnut street on the S. (very nearly), forms a basin or depression in the sand, upon which many small dwellings are crowded. The houses facing on Macumber's alley and those on Chestnut street, having their privies midway the triangular block, the wells of these houses being also in close proximity. Over this area, in times of great rain-fall, the soil-soakage was deep, the water standing in the three boundary streets to such a depth that it is necessary to dig ditches to carry it away to the regular ditches farther to the east. For several years the occurrence of diphtheria and enteric fever were so common that the casual relation between soil-soakage and these severe cases was a matter of discussion by physicians.

It is true that after this time diphtheria became quite prevalent elsewhere, even in the best drained portions of the city; but it was only after it had gained sufficient intensity in its original sites that it invaded the more salubrious quarters, and at no time was the disease so prevalent or so malignant as along the course of these rain ponds.*

It would be folly for rational people to wait until, by direct proof of the casual relation between contaminated drinking water and the typhoidal diseases, they are convinced. It is much more to the purpose to accept such reasoning as we are able to give with our imperfect knowledge, to-wit: Sickness prevails in a family; all other sources of contamination are sought for with negative results; the drinking water is examined. It reveals albuminoid ammonia, living organisms—products of stercoraceous infiltration. The well is abandoned; pure water is secured; the family is restored. The neighbors around, who persist in using the water despite the warning, keep sick, and they, too, after abandoning it for pure water, are restored. These are the demonstrations reasonable persons will appreciate.

Furthermore, a natural disgust for impure water should cause householders to look carefully into this subject.

Prof. A. R. Ledoux, Chemist of the State Board of Health, has written an article on †Drinking Waters, from which we quote the following:

"The most dangerous poisons in well water are the drainings of sewers, sinks, yards and privies, and the refuse from towns.

"These organic poisonous matters ooze through the soil into wells and springs, and, as before said, *may* not show any bad effect for some time, but sooner or later disease and death will surely visit the unsuspecting household and the physician's aid be sought in vain; for with every draught of water which passes the fevered lips the sufferer imbibes new poison and hastens the inevitable end. Moreover, the germs of many contagious diseases, which feed on filth and

* The objection that might be raised that diphtheria has prevailed where none of these conditions exists, we do not deny. The condition certainly intensifies the disease and increases the mortality.

† North Carolina Medical Journal, April, 1879.

multiply in foul water, are nurtured and preserved in warm climates through winter weather, by the equable temperature of wells and cisterns, and are ready to start anew on their errand of death when a favorable moment arrives.

"The city of Wilmington is no doubt above the general average of Southern cities in sanitary condition, but what a picture the February number of the Journal showed us. Think of it!

"'*There was one well two feet from the privy, two wells four feet from the privy, thirty-three wells ten feet from the privy, two hundred and twenty wells from twenty to thirty feet!*'

"The soil upon which Wilmington is located 'being nearly as white as the sea-shore *and as permeable!!*'

"It is not our purpose at present to depict the danger of such neglect of sanitary precautions, so much as to point to a remedy.

"1st. *We say unhesitatingly, if a well shows signs of contamination by sewerage or other like matter, fill it up!*

"2d. *Build all sinks and privies as far as possible from the well.*

"Through permeable soils and strata, dangerous liquids may ooze to a distance of many feet. We know of cases where wells have been used for years with no bad effect, when suddenly disease and death appeared. The poison, though slow in its course, had finally reached the well and a chemical analysis revealed contamination from privies thirty feet or more distant.

"The living organisms which are found in water are, some of them, injurious; some beneficial.

"Under favorable conditions of light, warmth, &c., countless millions of living things will spring into life in any water; the more impure the more abundant they will be. If the water is alkaline they will be animalculæ or infusoria; if acid, fungi, algæ, &c.

"They are never found in fresh rain water, but abundant in nearly every cistern. The office of infusoria is in water that of the buzzard on land: they are scavengers, and purify the liquid by feeding upon the decaying matters it contains. But the microscope reveals to us in water, contaminated with sewerage for instance, minute germs capable of motion, which, as in the case of the infusoria, live on the organic matter, but are believed to accompany, if not cause many forms of contagious disease, filling even the air in times of epidemic.

"To detect many of these impurities and dangers, chemical analysis and the microscope are sometimes indispensable, but the following rules may awaken suspicion and lead to a scientific investigation of the quality of drinking water in some cases:

"*A good drinking water is perfectly colorless and transparent, without smell or noticeable taste and agreeable to the palate. It should not lose its clearness in boiling and should have a very small residue on evaporation.*

"Where impurities are suspected, an analysis should be obtained, if possible,* if not, filtering through charcoal or sand, or boiling, will often either remove or render harmless various dangerous ingredients."

Disinfectants and Deodorants.—There is much misapplied energy, and much money wasted, upon deodorants and disinfectants. The folly of making the various substances coming under this head take the place of thorough cleansing is seen daily, and more especially in the summer months, when there is apprehension of the visitation of epidemics. If the truth were correctly stated, it would have to be acknowledged that it is only in these seasons of apprehension that such work is done at all, and then all lapses into a state of neglectfulness not to be accounted for on any other ground than that of ignorance of the objects to be attained.

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*Analyses of suspected waters will be performed free of charge by the State Chemist on application to Dr. Thomas F. Wood, Secretary of the Board, Wilmington.

We quote from the circular issued to householders, city authorities, boards of health, &c., by the New Jersey State Board of Health, this season, the following on

Disinfectants and How to Use Them.

Drafts of air for all floating foulness;

Dry rubbing for all easily detached foulness;

Wiping and water scrubbing for all attached foulness in most cases admit of no effective substitution.

Submersion in boiling water is applicable to the cleansing of all garments, utensils, &c., admitting of such a method; and dry boiling heat or freezing cold will also neutralize infective particles.

To disinfect a room, ship or building so needing disinfection that its contents and surfaces cannot be easily dealt with singly: Close the room or building, its windows, doors, and chimneys, so as to exclude the outer air as far as possible. Vacate the house. Break roll sulphur in small pieces, place it on an iron plate or other metalic dish, and set this on a pair of tongs or other cross bar over an iron pot in which there is water, or over a large box of sand, so as to avoid danger of fire from small particles of burning sulphur. Light it by a few hot coals or some alcohol poured around the sulphur and lighted. Then leave and shut the door after you. A pound and a half of sulphur is sufficient for 1,000 cubic feet of space. The sulphur will convert all the oxygen of the air into sulphurous acid, and all organic particles are likely to be changed. Keep closed three hours after the burning has ceased, and then air well six hours before occupying. Clothing and bedding needing disinfection may be hung on lines and left in the room. Most furniture is not permanently injured, but needs dry wiping and then washing off afterward.

Chloride of Lime.—A valuable disinfectant, chiefly because it contains from 30 to 35 per cent. of chlorine, which is liberated under proper methods of use. If purchased for cities, it should be tested as to the amount. It is not overrated as a disinfectant if only its quality is known and its mode of use is judicious.

It needs slight moistening, frequent stirring, and sometimes the addition of an acid, as vinegar or common spirits of salt. The test of its efficiency is that the odor of it be kept constantly perceptible.

Chlorinated Soda.—Usually known as Labarraque's solution, is a convenient liquid preparation valuable for use in saucers in the sick room or in utensils. Its odor should be perceptible to strangers entering.

Lime—Plaster—Charcoal—Dry earth—Sifted ashes.—All these have value, chiefly to be tested by the rapidity with which they correct odors. Fresh slaked lime should be scattered in all places of foul odor. It or charcoal or plaster may be scattered over heaps emitting foul odors. Calx powder is made by pounding one bushel of dry fresh charcoal and two bushels of stone lime and mixing them, and is of great practical use.

All these substances absorb foul gases and dry up moisture, and so help to retard decomposition, or else absorb its results. Where lump charcoal is used it may be refitted for use by reheating it.

Quick lime and ground plaster should not be used where they may be washed into pipes and form lime soap or obstruct by hardening.

The Metallic Disinfectants.—Sulphate of iron (copperas or green vitrol,) two pounds to a gallon of water, to be sprinkled freely in drains, cesspools, privy closets, soiled vessels or heaps of decaying matter which cannot be removed at once. One half of the strength will do where it is to stand in contact with the surfaces or in spittoons, water closets, houses, vessels or vaults.

One half pound of sulphate of iron (green vitrol), or one ounce of sulphate of zinc (white vitrol), or one ounce of sulphate of copper (blue vitrol), or one ounce of chloride of zinc, (butter of zinc), or one ounce of chloride of lime (bleaching powder), put to a quart of water—any one of these is available for neutralizing discharges or for sinks, used in quantities sufficient to cover the bulk they are inteded to disinfect.

Soiled garments may be put to soak in a half pound of sulphate of zinc (white vitrol), to three gallons of water. It will not stain or discolor most fabrics. One ounce of the chloride of lead dissolved in a pint of hot water and then a pailful of water added into which a handful of common salt has been thrown, serves a similar purpose. Also a half ounce of permanganate of potash to a gallon of water.

For washing, soiled garments should be put in boiling water, unless the character of the fabric forbids it. Powdered borax, one quarter of a pound to a gallon of water, is a good cleanser of clothing. Soiled hair, brushes, etc., are cleansed by it. Chloride of zinc, one quarter of a pound to a gallon of water, does not stain or discolor fabrics.

Parkes recommends two ounces of cloride of lime, or one ounce of sulphate of zinc, or one-half of a fluid ounce of chloride of zinc, to be added to each gallon of the boiling water in which the garments are thrown. On clothing that cannot be washed and does not need to be burned, after thorough shaking and airing, the sulphate of zinc or chloride of zinc solution may be sprinkled.

For general disinfection the following compound is available and valuable, and far better than most of the patented articles offered:

Sulphate of iron, (copperas,) forty pounds.

Sulphate of lime, (gypsum of plaster,) fifty pounds.

Sulphate of zinc, (white vitriol,) seven pounds.

Powdered charcoal, two pounds.

Mix well and scatter dry or wet it in small quantities and make into balls ready for use. Where a liquid is needed, stir in water in the proportion of a pound of the powder or ball to a gallon of water, and sprinkle when needed.

Carbolic Acid is valuable as an out-door disinfectant, to be added to the sulphate of iron solution, or to be used separately. Because of its own odor we cannot well test its effect in correcting other smells. We would test specimens or use only Sqibbs' Liquid, No. 1, because sure of its strength to be diluted by adding from fifty to one hundred parts of water, according to the mode of its employment. It is seldom required if the other articles named are properly used. Carbolic acid and cloride of lime must not be used together.

Remember that we do not know that any chemical disinfectants destroy the germs of a disease.

They only neutralize or suspend the action of those artificial disease producers or fertilizers which the bad administration of cities or householders, or interference with natural laws, or neglect of cleanliness has provided. We are to rely on these paliatives or correctives only while we are preparing for radical methods of prevention.

N. B.—The only reason why the death rate of your city or your township is over 15 to the 1,000, or why the sickness and invalid rate is a multiple of this, is because you are the victims of nuisances which admit of abatement.

Present Wholesale Prices of Disinfectants:

Sulphate of Iron (Copperas, Green Vitriol), 1½ cents per pound.

Sulphate of Zinc (Vitriol), 6 cents.

Chloride of Lime (in bulk), 2 cents per pound; in packages, 6 cents.

Sulphur Roll, 2½ cents per pound.

Carbolic Acid (No. 1 Squibbs), 30 cents per pound.

Zinc and Carbolic Acid, disinfectant of N. Y. Board of Health, 40 cents per gallon.

Permanganate Crystals, $1.10 per pound.

Fifty per cent. solution Chloride of Zinc, 25 cents per pound.

Solution of Chlorinated Soda (Labarraque's), 10 cents a pound.

The National Board of Health issued directions relative to disinfection and precautionary measures, from which we quote. This circular was prepared more especially for limiting the spread of yellow fever, but is marked with moderation and sound sense.

The National Board deems it prudent to adopt the word "germ" to signify that "something which is capable of growth and propagation outside the living human body that this germ flourishes, especially in decaying organic matter or filth, and that disinfection must have reference both to the germ and to that in or on which it flourishes."

1. Disinfection, when used in a place not infected, for the purpose of rendering filth, or foul soils, waters, &c., incapable of propagating disease germs, is a poor substitute for cleanliness, and is mainly useful to make the process of cleansing odorless and harmless. The best disinfectants for this purpose are sulphate of iron, carbolic acid, fresh quicklime, fresh charcoal powder, chloride of zinc, chloride of aluminium, and permanganate of potash.

"2. The two great difficulties in destroying the vitality of the germ of yellow fever are, first, to bring the disinfecting agent into actual contact with the germ; and, second, to avoid injuring or destroying other things which should be preserved.

"*When the germ of yellow fever is dry or partially dried no gaseous disinfectants can be relied on to destroy it.* It must either be moistened or subjected to a dry heat of not less than 250° F. to obtain security.

"4. In disinfecting or destroying infected clothing, bedding, or movable articles, *move them if possible while dry.*

Before disturbing them have them thoroughly moistened either with a chemical disinfecting solution or with boiling water, in order to prevent the diffusion of dried germs in the air in the form of dust.

"5. The best method of disinfecting rooms, buildings, ships, &c., is still doubtful, owing to the difficulty of destroying the vitality of dried germs.

The Board proposes to have this subject carefully investigated, and in the meantime advises thorough scrubbing and moist cleansing to be followed by the fumes of burning sulphur at the rate of 18 ounces per 1,000 cubic feet of space to be disinfected.

The sulphur should be broken in small pieces, burned over vessels containing water or sand, which vessels should be distributed in the closed space to be disinfected at the rate of one pound to each 100 square feet of area of floor.

"6. No patented compound known to the Board is superior as a disinfectant to the agents above mentioned, and none is so cheap. Some of these patent disinfectants are good deodorants, but *the removal of an unpleasant odor is no proof that true disinfection has been accomplished.*

It is important to observe in the above advice how much stress is laid upon the difficulty of destroying the infective principle of disease (germs) in houses occupied or on clothing worn by sick persons, when moisture is not previously applied, a thought that will lead to good results.

Appendix C.

SANITARY ENGINEERING,

By William Cain, C. E.

CHAPTER I.

GENERAL CONSIDERATIONS.

Death Rates Lowered by Sanitary Works.—We are told upon the best authority that in England there occurs annually upwards of four million cases of preventable sickness; and that 125,000 persons are premature cut off every year from a neglect of sanitary precautions.

Now if this be true in a country which has adopted the best known sanitary precautions, at great expense, how much more significant will the records in this State appear, where the only outlay that may be classed under the head "sanitary," is generally made in meeting *doctors' bills* and *funeral expenses.*

It is further stated that in England, since the sanitary precautions have been instituted, that the death rate has been lowered by from one-fourth to one-third, and is besides decreasing from year to year. The following table, referring to a *few* localities in England, taken from Latham's "Sanitary Engineering," speaks more forcibly than all the other arguments that may be presented, especially to those who have paid but little attention to sanitary subjects, and are inclined to be skeptical as to the great actual saving of life that may be attained. I presume the table is made out for 1873, the date of the publication, and that the "works" are of the "water sewerage" kind:

Name of Place.	Population in 1861.	Average mortality per 1,000 before con'tion of works.	Average mortality per 1,000 since comple'n of works.	Saving of life. Per cent.	Reduction of typhoid fever. Rate per cent.	Reduction in rate of phthisis. Per cent.
Banbury	10,238	23.4	20.5	12½	48	41
Cardiff	32,954	33.2	22.6	32	40	17
Corydon	30,229	23.7	18.6	22	63	17
Dover	23,108	22.6	20.9	7	36	20
Ely	7,847	23.9	20.5	14	56	47
Leicester	68,056	26.4	25.2	4½	48	32
Macclesfield	27,475	29.8	23.7	20	48	31
Merthyr	52,778	33.2	26.2	18	60	11
Newport	24,756	31.8	21.6	32	36	32
Rugby	7,818	19.1	18.6	2½	10	43
Salisbury	9,030	27.5	21.9	20	75	49
Warwick	10,570	22.7	21	7½	52	19

A previous statement would indicate that the death rate is still being steadily lowered. As Latham states, the most healthy districts show but a small saving compared with the others; though nearly all show a marked diminution in certain diseases—typhoid fever and phthisis.

Similar results have attended the enforcement of sanitary measures in some of our American cities.

A striking illustration is St. Louis, where, it is stated, that from 1867 (when the Board of Health was organized,) to 1877, although the population had more than doubled, the death rate had decreased, so that actually in 1877 there were fewer deaths than in 1867.

The average mortality for this country is about 20, ranging from 17 to 30 in 1,000 generally; but St. Louis shows a death rate of only 11, which apart from its site, "must be ascribed largely to its excellent water supply and sewer system."

Economical Aspects.—Apart from the humanitarian view of this question, it may be considered in its economical aspects: thus Latham has taken Croydon, where the total cost of sewers, &c., was $943,800, and estimated the saving in *funerals*, in *sickness* (allowing that for every life saved 25 would escape sickness, the saving being estimated at $5 for every sick person,) and in the *labor*, for 6½ years only, by the prevention of premature death, at a total of over $1,000,000, which thus exceeds, in the short space of 6½ years, the total cost of the sanitary works.

Yellow Fever Caused by Filth.—How much more striking would be the result, were we to take some of our own plague-stricken cities in America! *Where has the yellow fever its origin?* In the filthiest port in the world, Havana, where "the tide being almost imperceptible, all the emptyings of the sewers remain in the harbor until they become a fœtid and revolting mass of corruption." From there the seeds of the yellow fever are carried by ships to other ports; and when these are foul the scourge begins.

Gen. Butler at least has the merit of having to a great extent kept New Orleans clean and free from the epidemic during his occupancy of the city. In 1878, however, in consequence of the foulness of the city, she suffered the most terrible visitation; whilst in 1879, through the energetic workings of some of her most public-spirited citizens, in carrying out sanitary measures, the mortality from yellow fever was very much reduced.

Galveston was kept clean and escaped the plague. Huntsville, Ala., actually sheltered yellow fever victims with impunity; whilst Memphis, in 1879, again suffered from her foulness.

What more instructive lesson than the facts just given?

Advantages of Keeping Clean.—If we keep clean there is less chance of dying, greater enjoyment of life from increased health, fewer bereavements, and a positive pecuniary gain to the community, even including the cost of sanitary works. Health, population, and money values also, generally go hand in hand, when other conditions are favorable.

On the contrary, if we disobey the Divine Will, by running counter to natural laws, we are punished for the sin of disobedience. Here we have rewards and punishments—both teaching their own moral lessons. Choose between them.

Is North Carolina Clean.—Let us now inquire as to our own cleanliness, which, the Good Book tells us, is next to Godliness. The result of this inquiry would be, that typhoid fevers, diphtheria, and certain interic fevers *that are now classed as "filth diseases,"* are common, especially in the larger towns of the State; and that these diseases are sufficiently accounted for by *bad wells, foul yards, privies* and *cesspools;* the latter tainting the air with their gases and the water with their dissolved impurities.

There are but few privies in the State that ought not to be abolished, and some good system substituted in their place. It is one object of this paper to suggest such systems.

But it is not sufficient that our own house alone be free from reproach. The individual may suffer when it is only his neighbors who are to blame. The whole community, as a unit, must practice cleanliness.

The germ of disease, engendered amid the surroundings of filth, if wafted to the palace, can strike as deadly a blow there as in the dirty hovel, as recent examples show.

Filth and Disease go Hand in Hand.—Of the exact nature of the poison generated by filth we know little; but it has certainly been demonstrated in numerous cases that the ravages of epidemics are in direct proportion to the foulness of the locality. Thus in one city, diphtheria followed the line of bad sewers; in another, of bad wells. Bad water is one of the most efficient agents in spreading disease.

The cholera of 1853, in London, attacked districts furnished with unfiltered Thames water with 3½ times the severity experienced by neighboring districts supplied with Thames water filtered through sand and charcoal.

It has become as it were an accepted truth in sanitary science that the fatal effects of epidemics may either be prevented, or their spread materially hindered by a proper attention to sanitary precautions. These precautions simply consist in the having, at all times, *pure air*, *wholesome food*, and *good water*. It is only the first and last of these requisites that will be considered in what follows, as they pertain more especially to the science of "Sanitary Engineering;" though it is to be observed that wholesome food is to a certain extent dependent upon the good water or milk used in the cooking.

By a disregard of these prerequisites to health—and they are more or less disregarded by us all—we enfeeble the system, suffer a loss of vital energy, and are thus fit subjects for an attack by the first epidemic.

The "debilitating effects" of large cities are mainly due to the poisonous gases, generated by the putrid matter of sinks, sewers, &c., which gases find their way into chambers through faulty pipes and traps, or are otherwise diffused through the atmosphere. When the debilitated person seeks the pure water and bracing air of the mountains, the relief is almost instantaneous, thus proving the life-giving qualitiei of pure air and pure water.

The Science of Prevention.—The Science of Medicine, so long confined to the art of healing alone, now declares in favor of the *Science of Prevention* as the higher philosophy.

Let us, then, state the principles of this latter science clearly and succinctly; not entering into many details, but giving mainly those principles and facts that should be known by every one. Any system proposed must be a simple one—the simplest is generally the best—to meet the needs and comprehension of all classes.

The law organizing the North Carolina Board of Health requires a monthly report from each county on vital statistics. It is of great importance that this law be faithfully carried out, so that the effect of the suggestions given below, where carried out, may be ascertained.

The same act requires that the Board "shall gather information, for distribution among the people, with the especial purpose of informing them about preventable diseases."

Disease may be prevented, other conditions being favorable, by a proper attention to *drainage, ventilation, water supply*, and the prompt disposition of *sewage matters.*

We shall consider the subject in the above order.

CHAPTER II.

DRAINAGE.

WET AND DRY SOILS.—The farmer well knows that when a wet soil is not drained, valuable plants refuse to grow, due to the land being "cold" and "sour;" and that by drainage such lands are often converted into the best quality of lands, owing to the replacement of the excess of water and vegetable acids by warm, dry air, so that the roots now find the proper amount of air, moisture and temperature to satisfy the conditions of growth.

The sun's rays now cause a *healthy* decomposition of organic substances, in place of the imperfect one that seems the necessary concomitant of moisture in excess; so that now neither acids are formed in the ground, nor dangerous organic impurities thrown off into the air.

It is the latter that produce, indirectly or otherwise, the *intermittent and remittent fevers*, so common over the whole South. The best cure is *drainage.*

"The fens of Lincolnshire, in England, and marshy districts along the lower Thames were formerly greatly scourged with fever and ague and with malarial neuralgia. The extensive drainage operations carried on in these districts have had the effect of removing these ailments entirely."

Where ground is water-logged, it is unfit for human habitation.

Drainage is especially necessary where sewers are laid, as the sewer gases readily penetrate the brick walls of the sewers, and then find access to cellars, etc. A dry soil will condense enough oxygen to burn these gases up, as will be more fully explained further on.

MALARIAL POISON.—It is generally believed that all damp places, as most ponds, marshes, swamps, river bottoms subject to overflow, etc., *portions of which, along the banks, are alternately wet and dry*, are such as originate malarial poison, and must continue to originate it so long as such conditions hold. The occasional overflow of salt water aggravates the evil, as also the accumulation of leaves, decaying wood, etc., especially where thick vegetation causes a stagnation of the air, with dense shade. It is obviously correct, then, to cut down such vegetation immediately around the damp locality, drain it and put it under cultivation. If the rise and fall of the water, in the pond or marsh, alternately covers and exposes much of the banks—*i. e.*, if the banks are not vertical, or made so—then the body of water must be entirely drained off if possible; otherwise the injurious decompositions due to wet soils will continue to go on and breed malaria. It is found that winds can transport malaria some miles. It is therefore best not to cut down open forests at a little distance from the damp localities, as they intercept the malaria to a considerable extent.

It is very often the case that dwelling houses, in city and country both, are surrounded with such a dense mass of shrubbery (perhaps intended to satisfy the æsthetic taste) as to cut off both fresh air and sunshine; thus rendering the house and yard damp and the air impure. Such vaults should be rendered habitable by the free use of the axe. It is not well to have too much shade in our cities; pure air and sunshine are the best purifying agents we have. It is a custom (but rarely "honored in the breach") to deny earnestly and with many asseverations that malaria effects the locality one lives in. Sad must be the condition of that person, who, even if he admits an occasional malarial fever, cannot point out another locality where the malady is infinitely more distressing.

Acting upon this recognized principle, it is suggested that whilst the mountains and hilly regions hardly ever originate fever and ague, that much of the remainder of the State is subject to it to a greater or less extent, and therefore that thorough drainage is one of the first requisites to increased healthfulness. Whilst thinly settled districts may not be able to institute proper precautions, yet the larger towns can drain the ponds, low places, roads, and mother earth generally, in their vicinity.

In the last column of the previous table is seen the reduction in the death-rate from phthisis of twelve English towns. "This saving of life is ascribed to the effect of drainage works in drying the subsoil of those places."

In this State, Salisbury may be given as an instance where the drainage of a large pond near the town has very largely diminished the prevalence of malarial fevers.

Subsoil Drainage.—In the subsoil drainage of streets and roads, *covered drains,* formed of rock or tile, should be used in preference to open drains. Open drains, unless the soil is very tenacious, and can stand at a steep slope, take up too much space. Besides they are constantly needing repairs and often hold stagnant water and decayed filth ; so that in some countries their courses have been marked by excessive ravages of cholera over adjoining districts.

A given tract of land is best drained for agricultural purposes by stone or pipe drains of 1 to 2 inches diameter, running straight down the hillsides (when not too steep), in parallel rows, 25 to 50 feet apart, and 30 to 36 inches below the surface. These small drains discharge into larger intercepting drains, run down the hollows ; and these, in turn, empty into larger drains (that may often be open), that follow the courses of the valleys and perhaps serve as the water channels of small streams. Such draining necessarily ensures a deep, mellow soil, that not only satisfies the needs of agriculture, but is in perfect keeping with the requirements of health. Towns should at least keep the subsoil dry, by covered drains run along the streets and elsewhere, at sufficient depths to drain the cellars thoroughly and to prevent standing pools of water.

Tile drains 2 inches in diameter, under the side-ditches, or one 3-inch drain under the middle of the road, is sufficient generally. An outlet drain should run from the depressions in the road. A drain or culvert crossing the road should be large enough to pass 2 inches of rainfall in one hour when the drainage area is small, 1 inch for a valley two to three miles long, and so on.

All streets and roads should be built higher in the middle than at the sides, and should have gutters deep enough to carry off storm waters, unless there are specially constructed large drains for this purpose (as to which see "Water Sewerage," further on).

Complete Drainage.—If such drains (designed to carry off *all* the rain water, slops and waste water, that is not absorbed by the ground,) are contemplated, regard must be paid, in laying them, to the future sewerage of the town, even if this is not carried on at the same time as the drainage system proper.

The drainage of large districts, swamp lands, low lands, etc., varies so with the configuration of the ground that it is impossible to give any set of rules that apply in all cases. As a rule, the district is intersected by a number of dykes, often parallel, that drain into larger dykes or streams.

Intercepting dykes are often dug around the whole area to be drained to prevent the access of water from without.

As an illustration, the low "Landes" in France may be given. Here 260,000 acres of the richest lands in France have been reclaimed, chiefly by cutting open canals 16 to 20 feet wide, following the natural slope of the plateau with a fall of 1 to 2 per 1,000. Of these canals 1,600 miles have been completed. For 75 miles along the coast, huge sand-banks protect the country from the sea, the drainage along them being received by a large collecting canal 40 feet wide. The works cost $1,700,000, about; and the value of the reclaimed land is estimated at upwards of $56,000,000.

"*The fevers which formerly ravaged the country have disappeared, and the country may now be considered one of the most healthy in France.*"

If the land is beneath the sea level, as in Holland, then the water must be pumped out of the area, the latter being protected from the encroachments of the sea by an embankment.

Straightening the course of rivers, likewise, is efficient in causing increased scour, a lowering of the bed and a lessened liability to overflow.

Ponds are easily drained by simply cutting a ditch of the proper size through the natural or artificial embankment surrounding them. The greater the extent of the water shed, and the greater the rainfall, and the imperviousness of the surface, the larger of course is the ditch.

The so-called "wet weather" ponds, often on high ground, should never be tolerated, as they present the very conditions for fostering malaria—a largre area, alternately wet and dry.*

The natural division of a country for drainage purposes is into districts belonging to the same water shed, bounded, of course, by the ridges and streams. Considerable inconvenience has been caused in some thickly settled countries by a disregard of natural boundaries.

The extent to which drains exert an influence on the

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*See Kerr's Geology of N. C., (Introduction) for an excellent presentation of the leading topographical features of the State, especially its swamps and pocosins, as relating to the matter in hand.

ground on either side depends on their depth, and the character of the soil, whether very retentive or porous. Their action is analagous to that of wells given further on, except that the bottom of the ditch does not generally reach the level of complete saturation of the ground as is often the case in wells.

It is best not to open new ditches from "June to November" in malarial districts, unless for house drainage. Cellars should be drained by leading a pipe from below the bottom of the cellar to some convenient exit to the open air at a lower level; or similar drains may be laid just outside of the building.

It is plain that greater attention should be paid to drainage in towns near our sea-coast than in the hilly regions, as decomposition is generally greater, due to increased moisture and temperature, not forgetting however that its neglect anywhere must cause pernicious effects.

CHAPTER III.

VENTILATION.

THE CONSTITUENTS OF THE AIR.—It has been found that in certain manufactories and machine shops that the air is so filled with certain impurities that 30 years is the maximum age attained by the operatives. Such instances (and they may be multiplied), though they indicate criminal neglect in the management, are fortunately exceptional, and need not be considered here.

The impurities that we shall consider under this head, as concerning ventilation, result from the *breathing of men and animals and the burning of gas, oil, etc.*, in illumination and heating.

Country air, wherever analyzed, is found to contain in volume nearly 1-5 *oxygen* to 4-5 *nitrogen*, with small variable amounts of aqueous vapor, ammonia, carbonic acid and certain microscopic organisms, besides dust, etc.

If phosphorus is burnt in a bell jar, placed over water, it combines with nearly all of the oxygen in the confined air, forming white fumes of "phosphorus pentoxide," that are soon entirely absorbed by the water, leaving nearly pure nitrogen in the jar. The water rises so as to fill about one-fifth of the original air space in the bell jar, thus showing that the substance (oxygen) abstracted is nearly one-fifth by volume of the whole. The gas (nitrogen) now remaining in the jar is colorless, inodorous, and does not support combustion or animal life. Pure oxygen gas, (which is readily obtained separately by heating mercury oxide or potassium chlorate, etc.), is likewise colorless and inodorous, but it supports combustion readily—iron even burning (oxidizing) in it with great brilliancy.

The oxygen is the life-giving principle of the air. An animal, however, exposed to pure oxygen gas is over-stimulated to such an extent that it soon dies. The nitrogen, therefore, acts as a diluent of the oxygen, and it is found that the above proportion of 4 to 1 cannot be much varied from without deleterious consequences ensuing. The oxygen is not *chemically* combined with the nitrogen, it is simply mixed with it as sugar is dissolved in water—the little atoms of the one penetrating the spaces between the atoms of the other without destroying the transparency of the medium.

Dr. Angus Smith has made a large number of analyses of air in various parts of Great Britain. The amount of oxygen by volume in 10,000 parts of air are given for various localities as follows:

Mountain air,	2099	parts.
Towns (average),	2096	"
Room (rather close),	2089	"
Pit of a theatre, 11.30 P. M.,	2074	"
Backs of houses and closets,	2070	"

When air contains only 1850 parts of oxygen to 10,000 of air, it will not support the combustion of a candle, neither will it support life long. The relative densities of oxygen and nitrogen are as 16 to 14, so that an average composition of air by weight in 10,000 parts is oxygen 2310, nitrogen 7690.

The invisible *aqueous vapor* exists in the air at all times in various quantities, often condensed as visible clouds, dew, etc. Its amount varies greatly with the temperature. Thus one cubic foot of air at 90° Fah. can hold 14.50 grains of aqueous vapor as invisible gas; whilst air at the freezing point, 32° Fah., can hold only 2.37 grains of water gas. The air in both cases is said to be "saturated," since it cannot hold any more water gas, as gas; any excess being precipitated as rain, or formed into the liquid particles constituting fog or cloud and becoming therefore visible. In fact suppose air, saturated at 90°, to be cooled down to 32° suddenly: then 12.13 grains of rain will fall for every cubic foot of air, leaving only a little over one-seventh of the original moisture in the air! It is upon this principle that the phenomena of rain, dew, etc., depend.

It will have been noticed by those who read the daily reports given by the signal stations, that there is a column marked "relative humidity." This gives the percentage of full saturation of the air at the time of observation. Thus, "relative humidity 60," would indicate that the air contains 60 per cent. by weight of the water gas it can hold, without fog forming.

From Kerr's Geology of North Carolina, p. 87, we find the average yearly humidities of several places as follows: Wilmington 57, Charlotte 65, St. Louis 67, London 80 and New Orleans 86; the first two giving only the mean from a little over one year's observations. Whilst in London fog is common, on the coast of the Red Sea a cloud never forms, the dryest air there during a simoon containing only one-fifteenth of the saturating quantity.

Now it is well known that excessive moisture is deleterious to weak throats, lungs, etc. As to the effect of extreme dryness, I am not informed, save that these little red-hot, panting cast-iron stoves produce a bad effect on the air, which is very much ameliorated by evaporating water in vessels placed over them. The bad effect must be due largely to the drying of the air. Thus to take our previous example, if the air near the stove is heated only from 32° to 90°, and we suppose it "saturated" at the lower temperature, then at the higher one it has only the same amount of water gas, but it can hold nearly seven times as much; and if we suppose it only half saturated at 32°, then at 90° it will be nearly as dry as the air of a withering simoon, and at highest temperatures much dryer! Such extremes cannot fail to be unwholesome, and therefore if stoves are to be used, let them be *large* and heated as little as will give the necessary warmth.

Another important constituent of the air is *ammonia*, though it exists in comparatively minute quantities (about 1 in 1,000,000 of air); still it is mainly from this ammonia that vegetables obtain the nitrogen necessary to form their seeds and fruit. It is given off from urine and stable manure, unless gypsum is added to fix it. It is not injurious by itself in small quantities and need not be further considered.

The most important, by far, of the inorganic air constituents, next to oxygen, is *carbonic acid.* Its amount varies within wide limits; thus in Scotland, mountain air contained 3.2 at top of mountain, to 3.4 at bottom, in 10,000 volumes. In London it varies from 3 in open parks to 3.4 on the Thames, and 4, as a rough average, on the streets. In Manchester, the amount of 6.8 to 10,000 was reached during fogs, which is slightly over the extreme allowance considered advisable, which has been fixed by some at 6 in 10,000 volumes. Carbonic acid is formed by the chemical combination of carbon with oxygen. Thus when wood, coal, oil or gas is burnt, earbonic acid is formed. It is also given off by the decay of wood, in certain decompositions, and in the breathing of animals. In fact, if the air in a jar is extracted and then returned from the lungs into the jar again, it will not support the combustion of a candle, although the amount of carbonic acid expired is only 5 per cent. The lungs and body likewise exhale *organic impurities*, about in proportion to the amount of carbonic acid thrown off, the nose readily detecting the vitiation due to this cause. It is thought by many that these organic impurities—fatty matters thrown off from the skin, particles of skin, odors, etc., from man and beast—although constituting only the one hundred millionth part of air in the country, or about the five millionth part in crowded cars, is still the most dangerous to man of the air constituents; for it is in every stage of decomposition, and must furnish food for the microscopical denizens of the air, some of which no doubt are scavengers, but others are thought by some to cause disease.

The Atmospheric Germs.—It is well known now that fermentation and certain chemical changes are brought about by minute vegetable or animal growths, whose natural habitat is the air. Tyndall has filtered air through cotton wool to put next the most decomposable substances, and found that no change occurred in them, whilst common air caused decomposition or fermentation to begin. These experiments pretty conclusively disprove the theory of "spontaneous generation." Whether epidemic diseases owe their origin to "atmospheric germs" is not certainly known as yet, but the theory is at least plausible, and explains many facts more fully than any other theory generally known.

We know this much, that sewer gas, even in the minutest quantity, is sometimes fatal, (which is not due to the chemical gases formed, for the chemist breathes them every day), at other times innocuous, especially when free ventilation has been secured. Similarly the discharges, and even garments of patients suffering with certain fevers can communicate the disease. Yellow fever, cholera, small-pox, etc., is transported in ships by mere clothing. These facts, in connection with the fact that certain organisms in the air seem to follow cholera (as was shown in Germany, and the microscope may reveal the same thing in connection with other epidemics), seem to point to the atmospheric germ as being connected intimately with certain diseases. While the truth is being worked out by scientists, let us make use of known facts and proceed to "scotch the snake" wherever its presence may be reasonably suspected.

Vitiation of the Air by Breathing and Illumination.—It is found that a man gives off somewhat over 6-10 of a cubic foot of carbonic acid per hour; that a lamp or two lighted candles produce the same amount, and that a gas jet, burning 3 cubic feet of gas per hour, produces as much carbonic acid per hour as two or three people. It is true that the gas gives off no organic impurities, but if not burning brightly the poisonous carbonic oxide is always formed.

If we adopt 6 volumes in 10,000 as the safe limit of the amount of carbonic acid to air, then it follows that for every man or lamp or two candles in a room, we must supply at least 1,000 cubic feet of pure hair in every hour to dilute the 6-10 cubic foot of carbonate acid formed. A gas jet will require two or three times as much pure air.

But since the admitted air contained carbonic acid, we must supply more air to not exceed the maximum adopted; thus if the admitted air contain three volumes in 10,000 of carbonic acid, we must admit 2,000 cubic feet for every person, since the 6-10 of carbonic acid admitted, added to the 6-10 expired per hour, gives the ratio of 12 to 20,000 or 6 to 10,000 allowed.

It is said by some, that experience in hospitals shows that from 2,000 to 3,000 cubic feet of fresh air should be admitted every hour for each individual; whilst again we are told that for a healthy person in a barrack room 1,200 cubic feet per hour will suffice, and that the vitiation, tested by the sense of smell, for hospitals is not perceptible when somewhat less than the 2,000 to 3,000 cubic feet are provided.

No fixed standard has thus been agreed upon. In fact, it doubtless varies with the climate and the health of the person. The Laplander can breathe impure air better than we, probably because the organic impurities thrown off by him are not so readily decomposed as in our warmer air. The carbonic acid formed by combustion and respiration being heavier than air at the same temperature, would sink to the floor; but in consequence of its high temperature, it first rises to the ceiling; so that as much as 60 to 70 parts of it in 10,000 of air has been found at the top of an ordinary sized room in which two people were sitting and three gas jets burning. *At the same temperature*, however, we should expect to find the largest amount of it at low elevations, thus vitiating the lower strata of the atmosphere, or room, very greatly. Fortunately, however, gases have the power of "diffusion," so that a heavy gas will actually rise to mix with a lighter gas; further, it will pass through membranes and thin plates of stucco to effect the same object, so that the amount of carbonic acid is not generally a function of the elevation of a locality.

Where a room has no flue or chimney to keep up a constant circulation, then openings should be provided near the top of the room to let the warmer impure gases out, and not let them cool and descend again to vitiate the air we breathe.

Vitiation by Perspiration.—In addition to the carbonic acid given off by the lungs and skin of a man, there is exhaled a considerable degree of moisture, generally loaded too with organic matter, which produces smell. The amount has been estimated at from 1.5 pounds to 2.5 pounds per day on an average. A high temperature, or exercise, causes greater perspiration, thus cooling the person somewhat.

The amount of moisture given off is considered by some in connection with the carbonic acid exhaled, to ascertain the theoretical amount of air to admit; but this theoretical amount for most houses is larger than healthy persons seem to require, according to certain experience. This is accounted for by the fact that opening doors and windows, especially if they are kept open for some time, the draft through cracks, &c., add very much to the volume of admitted air, though not considered in the computation.

LIME AS A PURIFIER.—If a house has been lately plastered or white-washed, the lime will, at first, take up the carbonic acid with avidity; so will any ordinary mortar; in fact, I have seen artificial stone made by passing the products of combustion of a stove (carbonic acid mainly) by a flue into a room where was placed the mortar, moulded into the required form. The lime of the mortar changed to carbonate of lime, which cemented firmly the grains of sand into a hard rock.

It destroys organisms to whitewash. It would seem, therefore, that a plastered wall whitewashed was better than either the "hard finish" or papering. The accumulation of filth in successive coats of papering in old houses is probably frightful. Most of us have seen the trunks of trees whitewashed. This seems to me a misdirected effort to promote health. Why should such indignity be practiced on our noblest growths, stopping up the pores of the bark and probably injuring the tree, in order to remove a little carbonic acid *out of doors*, where it is not in excess?

THE LEAVES OF PLANTS AS PURIFIERS.—The carbonic acid thrown off into the air by decomposition, lighting, heating and the breathing of animals, is taken up by the leaves of growing plants, where it is decomposed, by aid of the sun's rays; the carbon being appropriated to help make woody fibre, &c., and the oxygen being given back to the air to fit it for respiration. We cannot imitate this process in ventilation schemes, but have to resort to heated currents or to fans to expel the foul air from our rooms and leave it to nature to carry the foul air by the winds to her millions of laboratories and return to us pure. If there was *no* vegetable growth, however, it has been computed that the breathing of animals would not vitiate the air perceptibly, over the whole globe, in some thousands of years.

Limit to Ventilation Schemes.—It is impossible to change the air, *with comfort*, in a room, as often as the winds do, out of doors; but we can easily prevent the air in the rooms from becoming too impure to breathe. Even when there is no special attention paid to ventilation, it is found that the hotter inside air is going out continually, through every possible outlet, and cool fresh air coming in to take its place. In very open houses, ventilation is often secured by the poor construction, in spite of the inmates, but it is often at the sacrifice of comfort.

Ventilation by the Open Fire-place.—Let us now consider one method of supplying pure air to a room containing an open fire-place. A fire must be kept brightly burning in the fire-place, to heat the air in the chimney or flue, causing a difference of pressure in the external and internal air, so that the out-door air rushes in through every crack and crevice, even through the solid walls, and thus forces the foul air up the chimney.

It is found, however, by experience, that the openings mentioned are not generally sufficient to admit a sufficient volume of pure air. Hence our custom is, at intervals, when headaches or debility are experienced, to open the doors or windows "to let in a little fresh air." A wise precaution certainly; but it does not meet the whole case, for *air should be admitted without draft—i. e.*, without the influx of sharply defined cold currents, which, as is well known, produce colds, with their attendant evils. The problem has been solved, however, in several ways, the details of which are simple in the extreme.

Thus, if the lower sash of the window is raised a few inches and the opening below is completely closed by a strip of plank, there will still remain an opening between the sashes where they overlap, through which the air will pour, being necessarily directed upwards. It thus strikes the ceiling, and is then gradually diffused through the room without draft.

A common expedient of simply lowering the top sash allows the cold air to "trickle down" on our heads. In the latter case, however, a board may be placed at an inclination against the upper part of the sash, so as to give the enentering current an upward direction.

Either of these plans is liable to failure when curtains or blinds are used. So that a more generally applicable method would consist in boring holes through the upper part of the doors or walls, and giving the entering air an upward direction by means of inclined planes of some kind; or tubes of wood or iron may be passed through the walls and turned directly upwards on entering. They should extend to at least 7 feet above the floor.

The air in all cases should be drawn directly from outdoors, and not from passages or other rooms. The openings, moreover, should admit of being partially or entirely closed on very stormy and windy days. All of the above plans have been tried in dwellings, club-rooms, etc., with complete success.

The proper size of tube or opening to use must be determined by experience. Two tubes, of two inches diameter each, may be tried for an average-sized room for two persons. It is stated that "two square tubes, 5x5 inches, will keep a good-sized club-room *fresh*."

Now, this method of ventilation is dependent upon a fire being maintained at the lower level of the room to cause the currents to enter with sufficient velocity. The system fails in summer, when, however, we do not object to the draft caused by opening the doors and windows.

Known Properties of Air.—The mathematics of this branch of the subject, (which is not given, as it seems out of place here,) depends upon certain known properties of air which may be briefly mentioned. Thus 12.4 cubic feet of air weighs one pound, when at a temperature of 32° F, the barometric height being about 30 inches, the average pressure at the sea level.

Since air is compressible, (its volume varying inversely as the pressue,) it follows that as we ascend, the weight of the same volume of air becomes less, since there is less air above us than before, so that the same weight of air is not compressed into so small a place.

Air likewise expands or contracts 1-491 part of its volume for each degree Fahrenheit above or below the freezing point, the pressure remaining the same; so that 491 volumes of air at 32° becomes 499 volumes at 40°, 509 at 50°, 519 at 60°, 529 at 70°, 539 at 80°, and 549 volumes at 90°, whilst the 491 volumes at 32°F. become 479 at 20°, 469 at 10°, and 459 at 0° Fahrenheit.

Again, it is found that one pound of air can be raised 1° F. by the same amount of heat that will raise 0.2374 lbs. of water through one degree, the air being subjected to constant pressure.

From such data, in connection with the heat afforded by different fuels, and the laws affecting the flow of gases, we are enabled to compute the velocity of the air flowing out of the chimney, which is thus a measure of the inflow of the fresh air. Suffice it to say that the higher the chimney or flue the stronger the draught, as thereby the difference of weights of the heated air in the chimney and a similar column outside the chimney is greater.

Ventilation by Gas Jets.—In theatres and closed halls, a series of gas jets may be used to create a current, the heated air passing outdoors through flues placed directly over the gas jets.

It is stated that this plan has met with great success in two churches in New York, the size of one of them (Dr. Scudder's church) being 150x100, of the other (Dr. Hepworth's) 125x125; the first seating 2,200, and the second 2,400. There were 14 to 20, 12-inch round tin pipes, carried up in walls from near the floor to and above the roof. In each of these tubes was placed three gas burners, just above the registers that admit air from the outside. On simply heating some of these gas jets, the registers being opened the proper amount, there is caused a quick exhaust, under complete control, and an inflow of pure fresh air. There is an opening in the centre of the ceiling of the auditorium into an octagon shaped shaft 11 feet in diameter in one church, 16 in the other, extending above the roof, containing sashes and outlets to the outer air. Gas jets are placed under tubes in these shafts to increase the current. At other parts of the ceiling are similar shafts, etc. The numerous gas jets produce such a current that, *in warm weather*, the entire air of the church can be changed every five minutes. The churches are heated by hot air furnaces or steam coils. (See "Plumber and Sanitary Engineer," March, 1879.)

Ventilation by Fans.—Still another method of ventilation is by pumps and fans. Most generally, air is drawn from without by fans located in the basement, and is propelled along ducts—over steam pipes or furnaces, if it is to be heated—to openings into the various halls and rooms, from whence it escapes by suitable openings, generally placed in the roof. The air is often drawn from near the ground, but it is best, especially in densely populated cities, to draw the fresh air from a point 100 to 200 feet above the ground down vertical shafts. In Paris, the air is drawn down a shaft 180 feet in height, to supply the Assembly room. (See Appendix III for a description of the ventilation of the N. Y. Lunatic Asylum.)

GOOD EFFECTS OF VENTILATION.—It is evident how important a factor of health ventilation is in crowded school rooms; in fact in all places where crowds may congregate and speedily vitiate the air. The bad effects are everywhere admitted. The good effects of the systems proposed have been proved by mortuary statistics, especially in school houses and hospitals. In a Dublin hospital, in 1783, for 25 years when the ventilation was bad, 3,000 out of 18,000 children, born there, died within the first fortnight of their birth. With better ventilation in the succeeding 28 years, 550 died out of every 15,072.

The report of 1861 states that further improvements in ventilation have been made, and death from the " nine-day fits," which carried off most of the infants, was then almost unknown.

The record concerning ventilation in connection with lung diseases is equally striking. Such diseases thrive in cities where the smoke resulting from the burning of *coal* is charged with impurities, such as " hydrocarbons, sulphide of ammonium, carbonic oxide, and probably very minute quantities of arsenic." Even now the cry is going up from London for a purification of its amosphere from smoke. This evil we do not suffer much from in North Carolina, the populations being scattered and the cities small. But we need a thorough inspection of public buildings with a view to proper ventilation.

When it is known that 30 parts of carbonic acid to 10,000 of air is often found in theatres and public halls, which is five times the admissible amount, it will be admitted that reform is needed.

CUBIC SPACE ALLOWED.—*The amount of space per head allowed in the room by various authorities, varies from* 300 *to* 1,000 *cubic feet,* the amount being smaller when the room is only occasionally filled with its maximum number.

It is true that the air can be changed in a small room more frequently than in a large one to maintain the proper degree of purity, or rather impurity, but the increased draught may be objectionable. The amount of space *actually given* per head in various *school houses* varies from 70 to 100 to 200 cubic feet. The effect is that 12 parts of carbonic acid in 10,000 (double the admissible amount) is common, and even 20 and 50 parts are not unknown. The effect upon both teacher and pupils is of course headaches, listlessness and debility.

LIGHTING.—The proper lighting of school rooms is as necessary as ventilation. The light should come from *behind* the pupil on to the book or blackboard, when possible, and the windows should be *high*, as most of the available light comes from above the level of our heads. Lighting directly from the top is probably the most efficient means of all where practicable. The light should come mainly from one side—the side opposite the blackboards—and the pupils should sit with their backs to it. The desks should be at such heights that the book or paper, &c., shall not be too near the eyes, so that the tendency to near-sightedness may be prevented. This defect is becoming alarmingly prevalent, and the teacher should insist upon the pupil reading with the book at the proper distance to suit his vision, at all times.

USEFUL HINTS.—Finally, let it be impressed upon all that the sense of smell when coming from outdoors into a room should warn us when our rooms are foul, and that doors and windows should be opened when convenient, and articles of clothing and bedding should be aired frequently to purify them.

Also let it be remembered that even brick walls can transmit gases. "Pettenkofer got 2,650 to 3,320 cubic feet of air through the brick walls and crannies of his room, when the difference of temperature inside and outside was 34° F. When all the crannies had been carefully stopped up, 1,000 cubic feet per hour still came through the walls." Therefore, never allow filth about any room or cellar of the house, nor against the outside walls, for such filth will contaminate the air that comes into the room, and *has been found* to cause sickness. If the house is liable to such contagion from adjoining buildings, endeavor to make it as air-tight as possible, after providing for the admittance of the purest air that can be obtained through proper openings. The floors of all houses should be as tight as possible.

Heating.—Intimately connected with ventilation is heating; in fact the two have generally to be considered together. In cold weather we require more heat than our bodies generate to make up for the loss by radiation; at the same time we need fresh air to breathe.

How admirably are these two conditions realized around a good camp fire, on a still, cool night! The active worker has just enjoyed his hearty meal, as only a worker can, and with feet stretched to the fire—that heats him by direct radiation—and body well clad, inspires the cool, fresh air of the country that invigorates body and mind.

Cool air to breathe is as refreshing as cool water to drink, whilst air too warm may be compared with tepid water in its effects. This fact is universally admitted, and yet it has got to be the fashion, at the North especially, to heat houses by puffs of hot air from furnaces that would seem more properly in keeping with a drying house. Let us understand clearly the physical differences in the various methods of heating, and we can then form a more intelligent judgment as to the merits or demerits of each particular device.

The open fire heats solid bodies in front of it, by *direct radiation* of heat rays, which pass through the intervening air with scarcely any loss. Tyndall has shown that air, consisting simply of oxygen and nitrogen, intercepts but an extremely small number of heat rays passing through it. The aqueous vapour, found in all air, intercepts 30 to 100 times the heat that pure air does. Carbonic acid, per-fumes, etc., increase the absorption of heat by air. The water gas in the atmosphere, although constituting only, say ½ per cent. of it, yet intercepts nearly all the heat rays of the sun that do not reach the earth; and again prevents their too rapid radiation at night from the earth. As Tyndall says, "Aqueous vapour is a blanket, more necessary to the vegetable life of England than clothing is to man." The amount of heat, however, intercepted by the air between the fire of a room and solid objects in front of it, although small, yet *does* increase the temperature of the air somewhat, though it is usually neglected altogether. The air of the room is mainly warmed by "*convection*," from coming in contact with the solid objects that have a higher temperature; the air next the solid body being heated first, then rises, to be replaced by other air, which operation is repeated indefinitely, or until the whole mass is heated to the same temperature.

There is thus a continual circulation of the air in a room heated by an open fire place, and generally an efficient draught to keep the air from being too much fouled.

If the room is heated by STEAM OR HOT-WATER PIPES, the case is different. The direct radiation is small, as any one can test by trying to warm his feet at the pipes without actual contact. The warming is mainly effected, as in the case of STOVES (not over-heated) or HOT-AIR FURNACES, by the air being warmed by the heated pipes, stoves or furnaces, by convection, and this air by its circulation heats the room and its occupants. The air is thus warmer than the furniture in the room; whereas in heating by the open fire-place, the furniture, etc., is often warmer than the air. A person in the room would thus be continually radiating heat, unless the air was too warm for comfort. In addition to the objection to the warm air, *per se*, it has been previously explained that heating air causes it to become too *dry*; so that whilst the "relative humidity" out of doors may be 80, in doors it may be much less—a disproportion that cannot be conducive to health. In fact, as a writer humorously remarks, such drying houses "are drying the very flesh off the bones of the Americans."

Still, in large buildings it is generally impracticable to heat by direct radiation, and the inmates have to submit to be dried. Again it is stated that the rigor of the Northern climate requires that the air, even in dwelling-houses, be heated somewhat before being admitted. If so, then it is still practicable to heat it only to 50° or 70° F., and supplement with the open fire-place.

SUMMARY OF MODES OF HEATING IN THE ORDER OF MERIT.—We shall conclude this popular exposition of the subject by a condensed summary of the various modes of heating in vogue, in the same order of merit as that given by Prof. Fleming Jenkin, in "Healthy Houses" (Harper's Half Hour Series), a book that every one should have.

The open fire-place is best, although most expensive, as it heats by *radiation*, and secures ventilation.

Next follow, in the order of descending merit, hot water pipes, porcelain stoves, hot air pipes, cast iron stoves, and last and worst gas-stoves with no chimney. These pipes and stoves heat largely by *convection—i. e.*, by heating the air next to them, which rises and is diffused through the room, the cold air taking its place to be in turn heated, &c.

Iron stoves, especially when over-heated, emit a bad smell, supposed to arise from the charring or decomposition of organic substances in the air by their contact with the heated sides of the stove and pipe. Moreover, if the stove is red hot, the poisonous carbonic oxide and other gasses will pass through the red hot iron and thus enter the room. The air is charred and dried too much by iron stoves. The porcelain are far preferable. Hot air pipes are better, and moreover distribute the heat more uniformly; though if the furnace becomes red hot, poisonous carbonic oxide will pass into the pipes. Some describe the "hot air" as having the "life taken out of it." Hot water pipes are better than hot air pipes; the air is not over-heated, and a uniform temperature is preserved for a long time. It is much used in hot-houses, baths, drying-rooms, etc.

Exits must be provided for the foul air where the hot-air system, the water pipes or the gas-stoves are used. For comfort and cheerfulness, no device can equal the open fire-place, fed with coal, or oak and hickory wood, not ignoring either the historic pine.

The fresh air then comes in through the walls, tubes, etc., *cold*, with plenty of oxygen and perhaps ozone in it, and is gradually diffused through the room as it becomes heated, to give up the proper amount of oxygen required for respiration and combustion. What excuse can there be for close rooms, that breed debility of various kinds, when pure, fresh air can be obtained by us at such a small cost?

CHAPTER IV.

WATER SUPPLY.

All of our supplies of water are derived from rainfall, part of this rainfall evaporating again, part running off into the streams and thence into the ocean to be again distilled and sent back to us as clouds and rain, and part sinking into the earth and forming the small subterranean streams whioh furnish the water of our springs and wells. In running over or through the ground, this water takes up such salts as it meets that are soluble; Some of these, together with the air and carbonic acid dissolved, giving the pleasant taste to our usual potable waters.

Other salts and gases, derived from decaying organic matter—dead bodies, manure, filth, etc.—are harmful in the highest degree, and have bred mischief and death in innumerable cases.

The rain as it leaves the clouds is pure water generally but in falling to the ground, it not only carries with it mechanically much organic matter and dust that is floating in the air, but it dissolves various gases, as oxygen, nitrogen carbonic acid and ammonia (the usual constituents of the atmosphere) besides nitric acid (often formed in the air by the lightning's flash), and in the vicinity of manufacturing towns, the gases evolved in the processes used in the particular manufacture. Water readily dissolves certain gases. On simply shaking it up with air, the latter is readily dissolved. This principle is made use of in ærating the pure water that has been distilled from the salt water of the ocean, on board ships, thus making it drinkable.

The amount of oxygen, nitrogen, carbonic acid and ammonia commonly found in waters is small, particularly the ammonia; which last, it may be observed, water can dissolve in large quantities. All of these gases are easily expelled by simply boiling the water.

Rain water generally contains far less organic matter than river water. River waters, though, differ greatly in the amount and character of the matter, in solution and suspension, as regards potability. Thus, if water drains over an impervious stratum, as a granitic formation, the water is apt to be soft, and to contain but little solid matter in solution. Some waters of this character contain only from three to five grains of solid matter to the gallon; they possess a high solvent power on lead and iron pipes, but are otherwise of the best character.

Where the rocks consist largely of carbonates of lime or magnesia, the waters are apt to be hard, their action on lead and iron pipes is small, and they require a greater expenditure of soap in washing, but are not otherwise objectionable, unless the carbonates are greatly in excess.

It is stated that the health and physique of hard water districts is better than in soft water districts; the water furnishing an abundance of material needed in the formation of the bones.

Each "*degree of hardness*" (*i. e.*, each grain of chalk or sulphate of lime, dissolved in a gallon of water) will entail, however, the additional use of two-and-a-half ounces of soap for every 100 gallons of water; so that it is well to get rid of the carbonates in solution, if possible. This may be partially effected in two days; either by boiling the water, or by adding milk of lime. Both methods depend on the fact the water can dissolve only two grains per gallon of carbonate of lime, unless it contains carbonic acid in solution, when it can dissolve very much more.

Boiling expels the acid; thus reducing the amount of carbonate of lime in the water in solution to, at most, two grains per gallon. By the second, called "Clarke's process," the added lime-water combines chemically with all the free carbonic acid, forming carbonate of lime, which thus settles to the bottom, together with much of the original carbonate of lime, leaving only about two grains per gallon still in solution of carbonate of lime.

The milk of lime is made by shaking up a small quantity of quick lime in water.

Permanent hardness of water is caused by the presence of sulphates of lime and magnesia. Neither boiling nor Clarke's process can soften such water.

WELLS AND SPRINGS.—Where *wells* or *springs* are used as the source of water supply, great care should be taken that the surface in their vicinity be kept free from organic matter, which by oxidation and putrefaction readily forms soluble nitrates, ammonia and chlorides.

Such waters are often clear, pleasant to the taste, sparkling from the excess of carbonic acid and cool from the effects of the nitrates. Hence the senses cannot be relied on, without the aid of a chemical and microscopical analysis to decide whether our well water is fit to drink. Even when all filth, slops, etc., are removed to a distance, we can only infer that there is *no probable* contamination.

The geological structure—stratification, faults, character of the earth, etc.—should be studied in this connection. Thus it was found in a certain locality that wells very near a grave yard gave good water, whereas wells on the opposite side, several hundred yards off, in the direction of the dip of the strata, were polluted to a dangerous extent. The explanation is simply that water has a tendency to a flow along the planes of stratification, where the strata are well defined.

Numerous cases of fever, cholera, &c., have been traced to bad water; localities with wells situated on the subterranean current that flowed past the diseased refuse, cesspool, etc., being attacked, whilst neighboring localities were free from the epidemic. It is needless to specify particular instances. Let no wells be placed where kitchen refuse, slops, manure or any kind of focal matter can drain into them. Where no stratification exists, then, if possible, place the well two or three times its depth from any offending matter. A well can just as properly be dug next to the house as elsewhere, provided slops and kitchen refuse are emptied some distance from it. In one instance soapy water was found by analysis in one well, whose sparkling waters would never have suggested it. The whole of the slops of the establishment were thrown where they drained directly into the well.

It must be carefully borne in mind that the well is the point of least resistance to the numerous little streams entering it and that it may induce a flow from a considerable extent of the surrounding earth. Chemical analysis can only show if some of these little streams have been polluted; in fact, whether a well is the drainage receptacle of the filth on the surface or of the rotten cesspool—the disgrace of any land where it is found.

It is not intended to convey the idea that, before wells are dug, the underground water is necessarily flowing in little streams. On the contrary it is generally otherwise, particularly in very absorptive strata. Very hard rocks, of course hold but little water, except in the crevices, whilst very porous and absorptive strata, as the London chalk, are fully saturated with water from near the surface downwards, and only need tapping to afford it in large quantities.

The water thus contained in the ground is known as the "soil" or "ground" water. Where the earth is porous, absorptive and uniform in character, much more of the rain water passes into the ground to flow off along subterranean channels to some outlet, to appear at the surface again as springs, or to be pumped out of wells, than where the surface is more impervious.

The imaginary line connecting the water level of springs and wells (when not used) is called "the line of saturation." It has been found that in uniform earth this line of saturation generally rises with the ground, so that generally as we recede from the sea-coast, or a stream, the water level of the well rises, whilst its depth beneath the surface increases. This rule is often true even when there is a want of uniformity in the strata or in the configuration of the ground, though so much depends upon the inclination the beds have, and their relative permeability, that it is impossible to lay down any precise rules as to where water may be struck in any but the simplest cases.

This is still more evident if the rocks are contorted, fissured or faulted.

Some special cases may be given however. Thus if a porous stratum overlies an impervious one, the water descends through the former until it reaches the latter. Now as the lower stratum is level, or slopes towards its outcrop, or is depressed in the middle, the water which soaks through the porous stratum will eventually appear in the form of springs near the upper line of the outcrop of the lower stratum, or be mostly stored in the depression mentioned of this stratum. Unless the porous stratum is very shallow, wells may be dug in it, especially in the last case mentioned, with the expectation of getting a good supply of water.

Where the porous stratum is covered by an impervious one, it holds less water than in the previòus case, for it now receives no water except along its outcrop.

Where such porous strata, however, are of great extent and have a considerable outcrop (it may be in remote districts) a good supply of water may be expected.

In the latter case, if the porous stratum is again underlaid with an impervious one which is depressed in the middle, large quantities of water will collect in this basin under considerable hydrostatic pressure. If this pressure is sufficient to send water to the surface through a well-hole, the result is an artesian well, which wells are much resorted to in some countries.

In this State we need have no fears of a water famine if the various sources are utilized. In the Quarternary sand of the eastern portion of the State, wells only 15 feet deep are common, though the underlying Tertiary marls and older rocks may cause exceptional features. In the middle and western portion of the State, the rocks are sandstones, slates and various crystalline rocks, which are often fissured, faulted, contorted or intercepted by trap dykes; thus causing abnormal features: still, as the dip, except in the sandstone formation, is often considerable, there is not generally much difficulty in finding water on digging for it; so that the "diviner" with his witch hazel twig generally finds his predictions verified. Perhaps it would be the same if he did not invoke its mysterious powers to assist him! In the older rocks the water often collects in fissures. Instances are known where pumping from one well affects a remote one; whilst, on the other hand, owing to faults, dykes, change of dip, etc., wells very near together seem to have no connection.

As a rule, the wells are deeper in the older rocks; for, as the latter are more impervious than the sands of the later formations, less water is absorbed by them—more running off into the streams—therefore we should naturally expect to go deeper for a constant supply. Other things being equal, the deeper the well the purer the water, as it has filtered through a greater extent of earth.

The earth is thus a vast sponge, ready to afford water when tapped, that is generally of a better quality too than lake or river water in the vicinity.

Prof. Nichols (see "Filtration of Portable Waters,") has observed, that even when the well is situated near a stream, that "the water is generally clear and colorless, of a nearly uniform temperature, and differs in chemical character from that of neighboring streams or ponds, generally being somewhat harder."

On lowering the level of the water in such basins by pumping or otherwise, the ground water level is lowered next the basin to the same extent; but it is found that as we proceed from the well or basin, that this level is lowered less and less, until we reach a point which is not affected when the level of the water in the basin is kept at a certain minimum height, the friction and capilarity balancing gravity here; supposing always the rainfall not subject to much variation. In case of drought, of course the whole ground water level should be lowered.

As an illustration of the above principle, it was found on the Elbe, that when the water in a well, dug in an alluvial deposit, was kept constantly 8.2 feet below its normal level, that the height of the ground-water was affected in every direction for two hundred feet only.

Large basins, near streams, are often used as the source of water supply of whole towns. Now it is evident that if the water level is lowered in such a basin that since the water level in the intervening bank is lowered, that the river water will have a tendency to flow towards the well to make up the deficiency, unless the bottom and sides of the river have become coated with clay to such an extent as to be impervious, which is very apt to be the case unless the stream is very clear, or has a rapid current. Known examples seem to show little or no contamination from the river water when the basins are built 100 to 200 feet from the river. The basin is constructed *next* a stream, as there is apt to be a greater flow of ground-water there; beside the water in the stream can make up any deficiency by use of proper constructions.

Filtration.—This *natural filtration* of water through the soil, when the latter is good, is more efficient than any system of artificial filtration, which, when practiced on a large scale, generally consists in passing water through layers of sand and gravel about six feet deep. The finest sand is put at the top, the upper portion of which catches most of the suspended matters, and by the oxygen condensed in its pores, frees the water of a small portion of its organic matter.

As the sand becomes clogged, it is scraped off at top and fresh sand added.

It is well not to cause the water to flow through the filter at a rate greater than fifty gallons per square foot of surface per day. The water is usually several feet deep on the filter bed. The beds are scraped about a dozen times a year, oftener in summer than in winter.

When possible, it is best to construct settling-basins where the water can deposit much of its sediment before passing on to the filter beds.

In some rivers, the particles of clay in suspension are so fine as to readily pass through sand and even filter-paper. In such cases, charcoal pounded fine is the only resource. The action of a sand filter is two-fold, mechanical and chemical:

1st. Mechanical, in that suspended matters too large to pass through the pores of the filter are caught, as in a net; likewise much sediment that would otherwise pass through sticks to the grains of sand, due to the property of adhesion.

2nd. Chemical, for although sand filters have practically no action on dissolved mineral matter, yet an appreciable quantity of organic matter in solution, particularly certain kinds, are removed by filtration through them.

An experiment that any one can perform will illustrate this: Add a few drops of sulphate of indigo solution to some clear water; the water assumes an intense blue color, which color it retains on filtering through an ordinary filtering paper. But if we strew over the filtering paper some powdered charcoal (animal charcoal is best) the water comes through perfectly colorless. If we use earth in place of the charcoal, the water that passes through it is slightly colored, thus showing that earth is not so powerful an agent as charcoal. Now, evidently, here the earth or the charcoal have exercised a different influence from the filter paper alone. The filter paper will catch *suspended* matter. Thus muddy water passed through it may become clear, but it does not alter chemically the substance in *solution.* We have just seen, though, that earth or charcoal does, and the usual hypothesis to account for this fact is that "porous substances condense gases—air, oxygen, etc., in proportion to the extent of their interior surface," and this oxygen actually destroys by *slow combustion* the substance in question. The enormous amount of surface to volume of porous charcoal or piles of earth permits the condensation of a large amount of gas which stands ready to attack any chemical body that can be decomposed or altered by it.

Of course this chemical action must diminish the more the longer the filter is in action, as the oxygen is not so readily replaced when the filter is covered with water. If water is really *polluted* by sewage matters, it has been shown that it may be improved materially but not perfectly purified by filtration. It is, therefore, pertinent to ask, what amount and kinds of organic matter found in water render it unfit for drinking?

Evidently, we must consider the two questions together.

Organic matter, *per se*, cannot always be deleterious, otherwise soup would have to be ranked as poison. It is stated that the water of the Dismal Swamp, saturated with organic matter, is actually preferred by sea-going vessels to purer waters. Chemistry is perfectly able to determine the mineral salts dissolved in water, and medicine can pronounce upon the amounts that may be taken into the system without injury. Chemistry can likewise determine the amounts and kinds of organic matter in any water, and if the source is known to be bad, or the organic matter (especially the albuminoids) in excess over good potable waters in the vicinity, the chemist is able to form an intelligent opinion, at least as to the "possible amount of germ" or disease-producing power of the water.

London drinks Thames water principally, though "above the point where the supply is abstracted the river is contaminated by the excrements of more than 200,000 human beings."

Those who favor this water, claim that a polluted river purifies itself in its onward flow, the noxious matter being oxidized as it is tossed to and fro by the current and thus rendered innocuous, besides being more and more diluted. Again, fish eat fresh focal matter, and vegetation can abstract large quantities of it. Still, it is doubtful if this natural process is continued long enough to thoroughly destroy the hurtful part of the sewage.

Now can this Thames water be regarded as a fit source for water supply, having once been contaminated to a certain extent? "The noxious part of sewage is that which is held in mechanical suspension, and these globules are beyond the reach of the chemist, and, to a great extent, of the microscopist. There are only two processes by which it can be effectually removed; the one is boiling for a long time, and the other is by distillation, both impracticable on a large scale." "No process of filtration that has yet been devised will remove choleraic dejections from water." (Humber's Water Supply, p. 19.)

The organic matter is not then considered as fatal in itself, but as dangerous, when of certain kinds, as affording a refuge and breeding ground for the poison germs that attend an epidemic. A person may drink even diluted sewage with but slight inconvenience until this germ is once planted in it, when at once his beverage changes to a rank poison.

Whether we accept the germ theory or not, it is admitted that drinking foul water and breathing impure air debilitate the system and thus render it less able to withstand epidemics. Let us then follow the natural instincts and avoid polluted air and water, especially as North Carolina can afford the pure articles in such abundance.

Lead Poisoning.—There is one source of poisoning that may be considered by itself—*lead poisoning*, due to the use of lead cisterns and lead pipes.

Soft waters that contain oxygen oxidize the lead and then dissolve the lead oxide formed. Hard waters, containing free carbonic acid, form, on the contrary, carbonate of lead, which is only soluble to the extent of one part in seven thousand, unless there is much free carbonic acid present. Clarke's softening process lessens the action of water on lead. Peaty matters form a sort of protecting coating on the lead pipe that is very efficacious in preventing further action on the lead. One-tenth of a grain of lead per gallon of water may produce lead poisoning in time.

The presence of lead in water is easily detected by passing a current of sulphuretted hydrogen through a deep column of the acidified water. If the liquid becomes tinged of a brown color, it is due to the formation of lead sulphide. What is the remedy if the water is found to act continously on the lead? Simply abolish the lead cisterns for slate, or stone ware, or galvanized iron cisterns, and replace the lead pipes by wrought iron pipes with screw joints. The tin lined lead pipe has not proved satisfactory; a small flaw exposes the lead, a galvanic action between the two metals is commenced and the water is speedily poisoned.

It is of the greatest importance to observe that no cistern or water pipes should be placed where sewer gases may pass either through or over them, in contact with the water, since water is very absorbent of such gases.

Cistern Water.—Where rain water is used as the source of supply, it is collected from the house roofs and stored in *cisterns* of wood or brick in cement. The cistern, if of wood, should have a circular form; if of brick, any convenient form can be used, provided the earth is well rammed behind the walls, to enable the latter to withstand the outward pressure of the water. The cistern should be covered and ventilated.

The rain water as it descends brings down many impurities from the atmosphere, such as soot, acid fumes, oil, etc., particularly in the manufacturing centres; besides if organic impurities in the shape of dust, such as horse manure, etc., cover the roof, the water is further contaminated before it reaches the cistern. The character of the roof likewise, whether lead painted, formed of new shingles or decayed ones, etc., must be considered. We thus see that cistern water is not necessarily perfect, though it is probably better than well waters, for while it has not had the benefit of the natural filtration of the latter, still it has taken up no new salts from the ground, and has certainly escaped sewage contamination.

Nevertheless it should be filtered before being used. This is effected in various ways. One plan, when the brick cistern is used, is to divide the cistern by a porous wall into two equal parts. The foul water, let into the larger division, filters through the porous wall into the smaller division, from whence it is pumped over the house. The porous wall may be made of soft bricks, or of some filtering material, as porous tiles or blocks of animal (bone) charcoal, that may be placed in a frame which can slide in groves and be readily replaced when the filter has become clogged up.

The brick wall, although very efficient at first, becomes clogged up in a few months by solid matter, consisting, amongst other things, of insects, worms, etc.; so that the filtration then is rather an injury than a benefit, as chemical analysis has demonstrated. The solid matters that settle at the bottom of cisterns should, of course, be removed whenever practicable.

Domestic Filters.—With regard to domestic filters of any kind whatsoever, it may be observed that the filtering material requires renewal every few months.

The following is an extract from the "Sixth Report of the River Pollution Commissioners of England:"

"It cannot be too widely known that, as a rule, domestic filters constructed with sand, or sand and wood charcoal, are nearly useless after the lapse of four months, and positively deleterious after the lapse of a year."

"Of all material for domestic filtration, with which we have experimented, we find animal (bone) charcoal and spongy iron to be the most effective in the removal of organic matter from water."

"The removal of mineral constituents, and the consequent softening of the water, ceases in about a fortnight, but the withdrawal of organic matter still continues, though to a greatly diminished extent, when the filter is much used, even after the lapse of six months."

"We found that myriads of minute worms were devoloped in the animal charcoal, and passed out with the water when the filters were used for Thames water, and when the charcoal was not renewed at sufficiently short intervals, a serious drawback to its use."

The spongy iron is free from this trouble, but the filtered water, especially the first portions filtered, contain iron; and the softer the water the more iron dissolved.

On the whole, it would seem that for hard waters "Bischop's Spongy Iron Filter" is best, though the animal charcoal is an admirable material, when renewed every few months. Chemical analysis can alone tell when the filter has ceased action.

Both materials (spongy iron and animal charcoal,) remove about the same quantity of "albuminoid ammonia," say one-fourth, as a means of some very careful experiment, (Nichols on Filtration of Potable water), this substance being taken as the measure of the suspicious organic matter in solution.

From an analysis of Bischof (Humber's Water Supply) it would seem that the spongy iron (a metalic iron reduced from an oxide without fusion, and hence in a loose spongy state) was a more efficient agent than "magnetic carbide" and "selicated carbon," two other materials that have been used with success.

If animal charcoal is used, it should be in lumps in preference to blocks, though the latter gives good results. An admirable filter, that may be used in any cistern, consists of a metalic vessel with a perforated bottom, filled with animal charcoal and having a pipe leading from the top, which must be below the level of the water in the cistern. The water of the cistern passes up through the perforated bottom, then filters through the charcoal and is drawn off by the pipe when it is needed. The advantage of this arrangement is this: the suspended particles are caught mostly at the bottom of the filter and may become detached from the filter, especially if water is forced through it from the top in a downward direction at intervals. The filter can of course be taken out at any time and the material ærated or renewed. Many other materials have been used for filters of small size—sponge, sand, cotton, flannel, earthenware, common charcoal, etc. The small size filter acts simply as a strainer in a short time, and requires frequent renewing, otherwise it is worse than useless. Makers of all kinds of filters, however, do not hesitate to aver that they are self-cleansing, perfect, etc., etc., which, we have seen, is opposed to the best and latest scientific research on the subject. Let the householder be guided by the facts.

Where nothing better is at hand, water may be filtered through a box perforated at the bottom, containing clean quartz sand, resting on a plate of porous earthenware or on bricks placed on top of the charcoal. Expose the filter to the air from time to time.

PUBLIC SYSTEMS OF WATER SUPPLY.—It will probably not be long before our cities will demand purer water than can be supplied by the wells and springs now used; many of them being, without doubt, polluted by the many impurities thrown on the surface. This involves a *public system* of water supply, with its attendant system of reservoirs, filter beds, pipes, hydrants, etc. In view of such contingency, it may not be out of place to mention some of the requirements that such a system should fulfill.

The water may be obtained from lakes, rivers and streams, springs and wells, impounding reservoirs often being used to collect that which falls on the hill-sides into one place.

This water may be conveyed for distribution (Rawlinson's Suggestions to Local Sanitary Boards, England, p. 20,)—

By means of open conduits (before filtration);
" " " covered* conduits (always after filtration);
" " " cast iron pipes under pressure.

A water supply may be gravitating, or the water may be pumped by steam power. The relative economy of one or the other form of works will depend on details of cost and quality of water; as a rule, gravitating works require the largest capital. The annual working expenses of a pumping scheme may, however, be greatest. Reservoirs for service distribution should be covered.

If filters are used, the water should not be exposed in open reservoirs and tanks after filtration.

* Covered, to prevent the growth of vegetable organisms.

Cast iron pipes, properly varnished, should be used for street mains. Lead should not be used with soft water, either in service pipes or in cisterns. Wrought iron tubes with screw joints may be used for home service.

Water at and below six degrees of hardness is considered soft water; above this range, water is termed "hard."

These "suggestions" of Mr. Rawlinson, (Chief Engineering Inspector to the local government board, London,) are valuable, especially as they represent the best modern thought on this subject, and may tend to prevent fatal mistakes in designing water supply systems.

As he says, "The great modern improvement in water supply is the delivery by *constant service* and at *high pressure,* over the entire area of a town, and into every house, cottage and tenement, and should be secured where practicable."

The "constant supply at high pressure" permits consumers to draw water from the pipes at any time, and can be made so efficacious in the extinction of fires as to diminish their destructive effects most materially. Fire engines are not needed with such a system. It is said that in Paris, owing to the excellent organization of the fire department a destructive fire is almost unknown. The "*intermittent supply*" does not offer these advantages. House cisterns are required to stow the daily allowance of water, which is only supplied at certain hours. The cisterns, if neglected, may not be supplied with water, or they may leak, or absorb foul gases, and finally suffer from want of cleanliness.

There is besides the high pressure due to a sufficient elevation of the reservoir above the town, the "*Holly System*" of maintaining this high pressure in the pipes by *steam power.* The pumping machinery is placed near the water, which is pumped directly into the mains, the pressure being kept constant, or increased or diminished at will.

This system is highly spoken of wherever it has been tried.

SOURCE OF SUPPLY. AVAILABLE RAINFALL.—In any one of these systems, it is first requisite that the source of supply shall be constant and unfailing. Where a large stream is used as the source, the amount that can be depended on in the dryest seasons may be estimated with some degree of certainty. Where small lakes, springs, wells and small streams are used as the source, we have to depend, more or less, on the observed rainfalls for the different seasons, in conjunction with the measured flow of the streams, if any, to form, at best, only an approximate estimate of the yield.

Such observations should be conducted over a period of twenty years if possible, to include all fluctuations; but as a rule, in this State, we have only a few years' observations of rain fall, and only one or two of the flow of streams, to found an estimate upon the probable yield of water over a given drainage area.

Let us suppose that an embankment is thrown across a valley, to form a reservoir, into which shall be stored all the water that drains into the valley from its "catchment ground," whose area can be readily computed, as it is bounded generally by well defined ridge lines and the embankment in question. Now the yearly rainfall in different portions of the State varies from 20 to 60 odd inches the average being high, over 45 inches certainly. If al of this could be collected into reservoirs, the amount would be given by simply multiplying the catchment area by the depth of the rain fall; thus, if the catchment area was one square mile, 27,878,400 square feet, and the depth of rain fall one foot, we should have 27,878,400 cubic feet in a year or 76,379 cubic feet in one day for the supply. But in practice we are very far from securing the whole rain fall, the reason for which can be made plain by the following considerations.

Let us first suppose the catchment ground to be impermeable and free from vegetation; then any rain that falls all flows into the reservoir, except that lost by evaporation;

the latter being less *as* the surface is steeper, the temperature lower and the drainage area smaller.

If, however, the surface of the ground is *pervious*, as is usual, then a portion of the rain fall sinks into the ground, to appear again as springs, and thus drain ultimately into the reservoir, or else to pass off by some subterranean stratum to other outlets. In this case the amount lost by evaporation is less *as* the ground is more absorbent and better drained, the slopes steeper, and the temperature and area smaller. If now we suppose the earth more or less clothed with vegetation, the latter absorbs and partly evaporates still more water. The conditions of the problems are thus seen to vary greatly for different localities with the season of the year, and it may be added, also with the winds and relative humidity of the atmosphere.

In England, where observations have been conducted for years over many distinct catchment basins, the loss due to evaporation and absorption, has been found to range from nine to nineteen inches per annum, and it is the practice to consider as available no more than the mean fall for three consecutive dry years, (which is found to be, as a rule, $\frac{1}{6}$ less than the average rain fall,) after subtracting the loss by evaporation. Thus, if the mean fall for three consecutive dry years is about forty inches, and if the loss by evaporation and absorption is put at 20 inches, this would leave 20 inches of rain fall that could be utilized if it was *all* stored.

Observations on Lake Cochituate, Mass., water shed of 12,077 acres, from 1852 to 1875, gave a yearly rain fall varying from 35 to 69 inches—average 50, and the percentage of this received into the lake 25 to 74—average about 45. It is nevertheless recommended by some good engineers that not over 12 to 15 inches of rain fall be counted on as available in the United States, which is less than Humber allows.

The evaporation from the surface of *the water in the reser-*

voir, in dry seasons, averages about $\frac{1}{01}$ inch daily in England, whilst it is as much as $\frac{1}{2}$ inch in some localities in India. The annual loss in England is put at 20 to 25 inches. It is, of course, much more in small and shallow ponds, which can be more readily heated, than in extensive reservoirs or lakes. Trautwine says that the daily loss from evaporation in the three warmest months of the year will rarely exceed $\frac{3}{10}$ inch in any part of the United States. This is probably too high, for the same authority found in the tropics over a pond 8 feet deep, a loss of only 2 inches in 16 days, or $\frac{1}{8}$ inch per day. The thermometer reached 115° to 125° in the sun every day. It is evident from the foregoing the importance of early making observations in each locality for as long a period as possible, in order to ascertain the ratio of the "available" to the "total" rainfall. Rankine says that this ratio is about 1 for hard rocks, roof surfaces, paved streets, &c., $\frac{8}{10}$ to $\frac{6}{10}$ for pastures, $\frac{5}{10}$ to $\frac{4}{10}$ for flat cultivated country, and 0 for chalk. It follows that a catchment basin is best located in the older formations, consisting of hard rocks, whilst wells suit best the more previous and recent deposits. London is even now preparing to give up the Thames water altogether and to draw her supply from her underlying chalk beds.

It is important to note that the most reliable method of ascertaining the available rainfall is to measure the *actual discharge* of streams that drain a given water shed. Then by comparison with the total rainfall on the water shed, we find the actual amount lost by evaporation and absorption of the ground.

No town which contemplates a public water supply should neglect to have such observations made, covering a period as long as possible, to take proper accounts of droughts, &c.

Consumption per Head.—Statistics show that in England the *daily amount of water used in the towns and cities varies from* 15 *to* 50 *gallons per head*—30 being regarded as a full allowance. In the United States the daily consumption per head varies from 25 to 120 U. S. liquid gallons of 231 cubic inches (1 cubic foot—7.48052 pallons); and it is recommended by some to allow 40 to 50 gallons per head for smaller cities, and an increasing amount as the population increases.

It is very plain, from the records, that an enormous waste occurs in our cities, and special attention is now being directed to it. Where inspections, or water meters have been tried, the amount consumed has often been reduced to half and even one-third the original amount. Humber estimates that 20 to 25 gallons is a liberal allowance. Even if we assume double this, it still behooves us to take every precaution to avoid waste by the use of meters or otherwise; else the large yearly cost of the water supply may be needlessly doubled or trebled.

Reservoir Capacity.—Well, assuming, say 45 gallons, the *daily demand* on a reservoir is made up of the 45 gallons × number of population, plus the daily evaporation from the surface of the water, plus any compensation water to mill owners or others. Subtracting from this the dry weather flow of the streams discharging into the reservoir, we get "*the excess of the demand over the supply*" in dry months; and this multiplied by *the number of days storage* of the reservoir, gives its *available capacity*, or the volume it must contain between its highest and lowest working levels. Some advise that every storage reservoir should, if possible, contain six months of the excess of the daily demand above the daily supply for the dryest consecutive six months. Some English engineers formulate the following rule, as the result of considerable experience: "The number of days storage of reservoir" equals the number 1,000 divided by the square root of the rainfall in inches for three consecutive dry years. Thus, if this rainfall is 36 inches, the reservoir should contain 1,000÷6=166.7 days storage; that is, 166.7 times the excess of the demand over the dry weather supply.

The following table (see "Engineering News," August 23, 1879) will show the great disparity between the least and greatest flow of streams:

Name of River.	Drainage Area in Square Miles.	Flow of Cub. Ft. per Sq. Mile.	
		Greatest Flow.	Least Flow.
Connecticut	10,234	20.27	0.51
Merrimack	4,136	23.40	0.53
Schuylkill	1,800		0.21
Tyne, England	1,100	30.23	
Passaic	981	20.23	0.23
Croton	339	74.87	0.15
Concord	352	12.64	0.17
Hackensack	84		0.34
Sudbury	76	41.60	0.05
Croton, West Branch	20	54.43	0.02

"These figures show that on large drainage areas the proportional flow is less in freshets and greater in dry seasons than on small areas."

The "least flow" given above is probably the least flow on any day of the dry season. If, however, our reservoir is to contain, say six months supply, then we desire to know the least average flow for any six months during twenty or more years. Suppose this to be 0.2 cubic feet per second per square mile of drainage area, or 17,280 cubic feet per day per square mile.

Suppose a population of 10,000 consuming daily 6 cubic feet (45 gallons, say) per head, or 60,000 cubic feet in all; and that the loss by evaporatian from the reservoir of 10 acres say, is $\frac{1}{8}$ inch daily, or about 5,000 cubic feet. The total daily demand is thus 65,000 cubic feet, which is about 48,000 cubic in excess of the supply from the stream; so that if the reservoir is to contain 6 months=180 days of this excess, its available capacity must be $48{,}000 \times 180 = 8{,}640{,}000$ cubic feet, or an average available depth over the 10 acres of 20 feet.

It is evident that if the daily demand, as above, is 65,000 cubic feet, the yearly demand thus being 23,725,000 cubic feet, that but little over 10 inches of rainfall over the 1 square mile of drainage area has been secured, since 10 inches on a square mile gives only 23,232,000 cubic feet. This is certainly within reasonable bounds.

No allowance is made above for compensation to mill-owners.

Of course, by building the reservoir of sufficient capacity the whole of the rainfall, minus the loss by absorption, evaporation and leakage, can be utilized; but it has not been found desirable to build such huge reservoirs in actual practice, so that much of the rainfall is purposely allowed to run off.

Sources of Water Supply in North Carolina—Maintenance of Purity.—This State is abundantly supplied with unfailing sources of water supply in her many rivers and lakes, not to speak of the underground water, which hitherto has been the only source used in the supply of her largest towns. What a contrast to the rivers and streams of England—many of them fouled to inky blackness by the refuse of thousands of manufactories—present to our own waters, teeming with fish and drinkable almost everywhere. It is to be hoped that the enacting of wise laws will maintain their purity, by forbidding any injurious waste or crude sewage from entering them. If this system is inaugurated from the beginning, much trouble may be avoided. England now is making a brave effort to *regain* the pristine purity of her streams; let us be careful not to *lose* this thing of beauty in our own waters.

The foregoing notes are very brief, but they may contain some useful hints to our larger towns and cities, who will sooner or later abolish the polluted well and adopt a public system of water supply.

CHAPTER IV.

WATER SEWERAGE.

Then will likely follow the complex system of *water sewerage*, which is now regarded as the best for the largest cities; though it is admitted that it is a delicate machinery and requires the greatest care in its manipulation.

This system has been so thoroughly studied that a sufficient literature exists on the subject to answer the needs of practice; so that it is needless to enter into any very technical discussion of it here.

CONDITIONS THAT THE SYSTEM SHOULD FULFILL.—The object to be accomplished by the system is to carry all offensive matters underground, and *as rapidly as possible*, out of the city, by the aid of the water used in the houses and the rain water that falls. The proper carrying out of a system of this kind requires the aid of enlightened sanitary engineers of experience; above all, in the general design. Jenkin's "Healthy Houses," already referred to, is sufficient to show the general reader, not only the cause of many failures, but the remedy; in fact some of the conditions that the system should fulfill. Let it be borne in mind by any town contemplating the water system, that an error in design, like the bad foundation to a structure, is often very difficult to remedy.

Special emphasis is laid on the principle, that the sewage should be carried out of the town limits quickly—say in 24 hours, or less, when practicable. This is effected by a correct adjustment of the size and shape of the sewer to its fall, having assumed the total amount of sewage that is to be provided for daily. The question is one of hydraulics, and may be solved by the use of well known formulæ for the flow of water in channels.

Example.—As an illustration, take the following, from "Rawlinson's Suggestions": "The sewage of a town or village will consist of waste water and excreta from the houses, and the volume, in round figures, may range from 100 to 250 gallons per day from each house. This volume will probably flow off in about eight hours, so that the sewers must provide for not less than three times this volume, if even every drop of roof and surface water can be excluded. As this cannot in all cases be accomplished, the sewers should provide for not less than 1,000 gallons from each house; or for a town of 1,000 houses (5,500 population) have a delivering capacity of about 1,000,000 gallons (daily). An outlet sewer of 2 feet diameter, laid with a fall of 5 feet per mile, will deliver upwards of 2,000,000 gallons, flowing a little more than half full. Lesser diameters will answer where there are greater falls."

A 2 feet sewer thus provides for doubling the population in a few years.

Now 100 to 250 gallons per day, from each house containing 5½ persons, corresponds to from 18.2 to 45.5 gallons per day for each person, which figures represent about the extremes in English practice; 30 gallons being the usual allowance, excluding rain water.

In the case above, the velocity of the sewage of 11,000 persons is about 2 feet per second, which is the minimum velocity in order that so small a sewer may be *self-cleansing.* As the velocity is less for the real population of 5,500, especially if they use less water than 1,000,000 gallons, the inclination of the sewer should be increased if possible, or "flushing" will have to be restored to, or the sewer must be made smaller than the 2 feet diameter, to secure the proper velocity to make the sewer self-cleansing, and to prevent the formation of the poisonous sewer gases, which are always formed when the progress of the sewage out of the town is slow, in spite of all the ventilation schemes that may be tried.

A circular sewer, one foot in diameter, running half full, at an inclination of 1 to 600 will discharge 46.3 cubic feet per minute, at a velocity of 118 feet per minute, equivalent to a discharge of 167,000 gallons (in round numbers) in 8 hours. This is slightly over the discharge of 5,500 persons, allowing 30 gallons to each person, so that this one foot sewer would suffice if rain water is to be disregarded.

Amount of Rain Fall to Pass into Sewers.—Let us next ascertain the size of a sewer on the supposition that the town is one square mile in area, and that a rain fall of one inch in 24 hours actually drains into it. The rain fall is 2,323,200 cubic feet in 24 hours; or at the rate of 1,613 cubic feet in one minute. By use of proper formulæ, it is found that an egg-shaped sewer, $3\frac{1}{3}$ by 5 feet, running full, will discharge the water at a velocity of $3\frac{2}{3}$ feet per second, the inclination being taken, as at first, at only 5 feet to the mile.

We can now readily see, by this particular example, how much the size, and hence the cost, of sewers is increased by making provision to receive the rain fall. It is, of course, far more expensive to provide for the exceptionally heavy rain falls (as "6 inches in 2 hours," etc.,) which sometimes occur. Sewerage systems in this country do not provide for such exceptional rain falls.

The London sewers were construed to carry $\frac{1}{4}$ inch rain fall in 24 hours, at the time of maximum flew of sewage, larger amounts being provided for by storm water overflows.

It is found that different soils, or surfaces, have not the same absorptive power; thus in London the sewers in some sections deliver one-half the rain fall, whilst in entirely paved streets, nearly the whole of the water is drained into them.

Latham says that in Croyden, the soil being porous, gravel overlying chalk, "the amount of rain contributed by a storm of .72 inch in 12 hours, did not yield more than one-tenth of it to the sewers." More impervious districts required the full allowance of 1 inch in 24 hours, together with the sewage. In Dantzic, which is sandy and flat, $\frac{1}{4}$ inch in 24 hours, together with 2 cubic feet of sewage in 8 hours, was assumed as the basis for computations.

It is plain from what precedes, that any town contemplating a sewerage system, should be able to form some judgment as to the amount of rain water to be admitted to the sewers, if any at all.

ARGUMENTS FOR AND AGAINST EXCLUDING RAIN WATER FROM SEWERS.—The reasons for and against separation of the rain water may be stated as follows:

For Separation.—It is urged that even if a distinct set of sewers is used to convey away the rain water, that it is cheaper; since the rain water sewers can discharge into the nearest stream (thus giving it its natural volume) and can thus be made shorter than the sewage conduit, which is often carried a considerable distance; besides the sewage conduit is very much smaller and therefore cheaper in this case. Again, on account of the small size of the conduit, the sewage is carried out of town much more quickly; thus preventing that stagnation which sometimes occurs in large sewers, having only a thin film of sewage flowing slowly over the bottom, much of the solid material being deposited to decompose and generate the most hurtful gases.

Likewise, the manurial value of the sewage is increased and any expense of pumping very much diminished.

Against Separation.—It is urged on the other side, that chemical analysis shows that, in large cities, the storm waters wash away so much filth as to render the water as impure as the sewage; so that, at least, the first portions of the rain fall should be admitted into the sewage conduits, though the balance may be passed into the streams. Also there are objections to the use of so many pipes in the streets; two sets of sewage pipes, with smaller drains often crossing, besides gas and water pipes; the drainage pipes, too, having to be laid everywhere with a fall. It is plain, however, that if the surplus of the rain water is to be allowed to go where it can, that the old channels should at least be so much improved as to prevent flooding of cellars and formation of any stagnant pools anywhere. So much separate drainage should at least be insisted on.

It is certainly in the line of simplicity to adopt but one set of sewers; and experience shows that in most towns it rarely causes any inconvenience from flooding.

If drainage pipes have already been laid, they should not be abolished, even if sewers are afterwards projected.

SUBSOIL DRAINAGE.—If there is but one sewer system, then the *subsoil* must be drained by small pipes, simply butted together at the ends, so that the subsoil water can enter. The pipes must be placed *on top* of the sewer pipe to prevent any infiltration from the sewer, which often happens if they are placed below the sewer. This subsoil drainage is especially necessary in a retentive soil, to render the soil porous, so that it can more effectually do its work of oxidation on any gases that may pass through the sewer.

The latter should be rendered as impervious as possible, for leakage through bad sewers into the ground soon saturates it with the vilest poison, that invariably produces harm as soon as it can find an outlet to the outer air.

FORM, INCLINATION AND VENTILATION OF SEWERS.—Small circular sewers can be made of earthenware pipe, larger ones of brick in cement or of concrete, and egg shaped, to give a greater velocity to a small flow. Main sewers should not be laid at greater inclinations than cause a velocity of six feet per second, if possible, to avoid the cutting out of the bottom of the sewer by grit and other solids. The location of the main outlet sewer determines, to a great extent, the positions of the other sewers, and should receive special study. House drains should be trapped and ventilated between the house and sewer. The main sewers should be ventilated by direct communication with the external air, at least every 100 yards. This prevents that partial and noxious decomposition which occurs in close places having a limited amount of air. "In fully ventilated sewers the sew air is purer than that of some stables, or even in a crowded public room."

Nothing is so much insisted on in the best modern practice as thorough and complete *ventilation* of all sewers and house drains and pipes.

House Pipes.—Above all, in this water system, the house connections require the greatest care in their construction, and design to keep the lurking poison out of the house; and it is regretted that want of proper diagrams necessitates the ignoring of this branch of the water system in this paper.

Disposition of Sewage.—Having briefly considered some points of general interest in connection with the design of sewerage works, let us next enquire what is to be done with the sewage.

The plan most in vogue in this country is to discharge the sewage matter into some stream, which may thus be regarded, in one sense, as the continuation of the sewer.

In the case of tidal waters, however, if the refuse is emptied near the city it floats up and down the city, past it, giving anything but an air of cleanliness to the eye, or of satisfaction to the nose.

In England, the law now "requires that rivers and streams are not to be polluted by the admission of crude sewage, even from existing sewers.

Rawlinson states that up to October, 1878, "there are about 87 towns, districts, parishes, and places whose sewage is disposed of by *irrigation*. There are 23 towns, &c., whose sewage is disposed of by *precipitation*, treatment with *chemicals*, and partial *land-filtration*. There are 24 towns, &c., whose sewage is disposed of by ruder and more imperfect modes of filtration, as through charcoal, wicker work and straw. There are 16 towns, &c., whose sewage is disposed of by mechanical subsidence only." The sewage is first carried by the outlet sewer to the "sewer farm," where, if necessary, it is pumped into large tanks, to be then treated according to some of the methods given above.

IRRIGATION AND FILTRATION.—The best method probably is *irrigation*, or *filtration* through a porous soil.

This plan might be carried out by passing the sewage at intervals from large tanks, where it is collected, through hundreds of earthenware pipes, loosely jointed, placed about one foot below the surface of the ground and in parallel rows. The sewage leaks through the joints into the surrounding soil, which purifies it by absorption and oxidation. A better known method consists in simply passing the fluid sewage on to ground deeply drained. The purified water runs off in the drains.

By distributing the sewage over a sufficient extent of surface, it is found that the soil does its work perfectly; being aided, moreover, by the growing vegetation taking up much of the sewage through its roots. The purification, though, is principally due to the earth, which has the property of absorbing and condensing gases, such as air, &c.; so that each little particle of earth is surrounded with condensed oxygen, which acts upon the sewage matter the instant it comes in contact with it, and oxidizes the organic part,—throwing off some of it into the air—not as poisonous effluvia, which is the result of decomposition with a limited amount of oxygen, as in close drains, but as harmless aqueous vapor, carbonic acid and ammonia. The amount of oxygen absorbed by the soil is not large, but it seems to be replaced as rapidly as it enters into combination, and thus to furnish an indefinite supply to the matter with which it combines. (See Johnson's "How Crops Feed," pp. 218, 168, etc.)

It must, then, be distinctly understood that the putrescent substances are not simply absorbed (as usually stated) by the earth or charcoal, or other porous material; but are chemically changed—oxidized or burnt up—so that their objectionable features are no longer perceived; the nitrogen, etc., is thrown off into the air, or passes off in the water as nitrates, or nitrites, so that the earth ultimately has about the same constitution after its use in the manner indicated as before.

At Merthyr the effluent water from the filter beds was analyzed by Dr. Frankland, showing that when 230,500 and 1,200 people were draining on to them per acre, the effluent water was respectively 30, 16 and 3 or 4 times purer than the standard of fair potable water, so far as chemical analysis is taken as the criterion.

It is thus seen how effectually surface soil, where there is plenty of air, does its work. It is warmly advocated by Geo. E. Waring, Jr., (see "the Sanitary Condition of Dwelling Houses," Van Nostrand,) to get rid of all liquid refuse, about the country or town house, where there is no system of sewers, by passing it through loosely jointed pipes, laid about one foot below the surface in the back yard. He states that the system has been found to work admirably, winter and summer, wherever tried.

It may be stated that the efforts that have hitherto been made to utilize the fertilizing properties of sewage have not been profitable, unless in the way of irrigation. Fine crops have been raised on such sewage farms; so that where intermittent filtration is adopted, it is advisable to combine sewage farming with it to lessen the expense.

The Chemical Processes used so far have not been found to purify the sewage thoroughly by themselves, so that natural or artificial filtration must supplement any chemical treatment. Besides this objection to the chemical method its cost and difficulty of manipulating the accumulations of sewage sludge both make against it; still much of this sludge must be removed in some way before filtration can be employed.

In seaboard towns, the natural outfall for the sewage is the sea. If possible the sewage should be carried to such a distance as not to be brought back to the town by wind, tides or current. The same remarks apply to towns situated on tidal streams and estuaries.

Caution to our Cities.—Most of our large towns have a clean slate for sewerage systems. Let not a single sewer be built until a competent engineer plans the entire system, otherwise the sewers may have to be torn up eventually, or the engineer may be considerably embarrassed in his designs. The Secretary of the Board of Health, Dr. Wood, writes of Wilmington, that "there is an incipient sewer system here which promises to be a great nuisance, from the beginning they have made with it." It seems a pity for Wilmington to make a botch of it the very first move.

THE LIERNUR SYSTEM.

In a paper read before the Austrian Society of Engineers, Vienna, (see Baldwin Latham's "Sanitary Engineering," Am. ed.) Mr. J. Chailly says:

"The two conditions of removal without producing disagreeable odors, and carrying off the matter in short periods, are almost entirely fulfilled in Lieurnur's Pneumatic Sewerage system, in which the iron waste-pipes, which are water-tight and air-tight, are united to a system of iron pipes which run into a central station, where the air-pump is placed which pumps all the matter into a reservoir. The collection and sale of this matter does not usually cover the cost of the labor. The reports on this system are conflicting, and yet the majority of them speak in its favor."

Mr. C. Norman Bazalgette, in a late paper to the London Institution of Civil Engineer, says of this system from the experience gained at Leyden, Amsterdam and Dodrecht, that "it was supplementary to, and not substitutive of, a water carriage system, extremely costly, and its mechanism was extremely complicated and liable to get out of order. The accumulation of sewage residium in the central reservoir, and its subsequent decanting into barrels, were operations which could not fail to be objectionable and offensive. In conclusion, the system—though it might have a partial province in the tide-locked cities of the Hague, where no system of sewerage was available—should never be imported into an English town."

It would seem that there would be considerable difficulty experienced in the case of repairs to the pipes being needed.

THE ROCHEDALE PAIL SYSTEM.

This consists simply in half-barrels or pails being placed under the seats of the closed privy to receive the fecal discharges; the pails being removed about once a week, after putting on a hermetically tight cover, empty disinfected pails taking their place. The matter is carried out of the town at night, and may be spread on old fields, a slight covering of dry earth being used to keep down the smell; or the matter may be sold for manure. It is well to add dry earth, ashes or charcoal every day to the pails in use, and moreover to ventilate the privy.

This system is an excellent one for most of our towns and small cities. Having to carry the pails through the house or yard to the street is an objection. It is now being tried on a large scale in New Orleans, where the water system cannot be readily used.

All of our cities and towns can introduce this system with such a small outlay of capital, that it would seem to be the one just now to be most highly recommended.

The corporation should bear the expenses of the transportation of the excrementitious matter, as well as of other refuse and filth found in all towns, due to various causes.

THE DRY EARTH SYSTEM.

The great advantage offered by the "dry earth closet" is well known, and its admirable adaptability to the sick room.

The system proposed is founded on this, and consists in the same pails used in the preceding system, placed in *closed privies, on firm and dry plank or concrete foundation.* The only difference is, that in this system greater care is used in spreading charcoal or dry earth over the night soil, so as to burn it up as quickly as possible, and that the pails are emptied in a tight vault on the premises, a little earth being thrown on top of the emptied mass, to keep down odor and continue the work of exodation to completion.

There appeared an excellent article on "Village Sanitary Work" in *Scribner's* for June, 1877, by George E. Waring, Jr. The writer says: "In the autumn of 1876, I had brought to my house, where only earth closets are used, two small cart loads of garden earth, dried and sifted. This was used repeatedly in the closets, and when an increased quantity was required, additions were made of sifted anthracite ashes. The amount of material now on hand is about two tons, which is ample to furnish a supply of dry and decomposed material whenever it becomes necessary to fill the reservoirs of the closets. The accumulation under the seats is discharged through valves into brick vaults in the cellar. When these vaults become filled—about three times in a year—their contents, which are all thoroughly decomposed, are piled up in a dry and ventilated place, with a slight covering of fresh earth to keep down any oder that might arise. After a sufficient interval these heaps are ready for further use, there being no trace in any portion of foreign matter or any appearance or odor differing from that of an unused mixture of earth and ashes. In this way the material has been used over and over again, at least ten times, and there is no indication to the sense of any change in its condition."

The same earth can be used over and over again, thus doing away with what was once urged as the principal objection to the earth closet system—the continual removal of large bodies of earth.

A chemical analysis showed that there was no more organic matter in the used earth than in fresh earth, thus proving that in this case 800 pounds of nitrogen, etc., had gone back to the air in a harmless state, the solid organic matter being estimated at 800 pounds, of which some 230 was nitrogen.

The powerful disinfecting properties of *charcoal* are well known. When there is odor about a dead body, there is nothing better than carbon in some of its forms to destroy it. The smoke from burning tar, coffee, dried apples, etc., have all been successfully tried.

A covering of charcoal will preserve tainted flesh of any kind; the dog instinctively acts upon this principle when he buries a bone in the earth to make a repast upon some days or weeks afterwards. In all these cases it is not the charcoal or earth, but the oxygen contained in its pores that destroys the odors and burns up the substance.

As Mr. Waring says, "earth is not to be regarded as a vehicle for the inoffensive removal beyond the limits of the town of what has hitherto been its most troublesome product, but as a medium for bringing together the offensive ingredients of this product and the world's great scavenger, oxygen. This oxygen does its work of liberating the organic elements so well that, according to Professor Vœlcker, "the use of the same earth four or five times over, although perfectly successful in accomplishing the chief purpose of deodorization, fails to add to it a sufficient amount of fertilizing matter to make it an available commercial manure."

This agrees with the analysis previously mentioned. If the earth does its work thoroughly, the manure is lost, for, in truth, *this is the object to be accomplished;* to drive the organic elements back again, uncombined, or at least in harmless combinations, to the air; and this the condensed oxygen accomplishes.

One advantage of the system is that the privy or "commode," may be attached to the house; in fact the best earth closets may be kept in the chamber, without any other odor being perceived than that of the earth used, which should be *fine*, *dry* and *sifted.*

This dry earth system is familiar to soldiers of the late war, the sinks used by them receiving daily a slight covering of the very earth thrown out in their construction. This effectually prevented deleterious effects; and in exact accordance with the theory and facts previously adduced, the organic matter was so soon dissipated—when the system was carried out faithfully—that the earth was not worth removal as manure. This fact I know from experience; and it agrees with all other experiments and analyses referring to this point. When the earth covering is too slight, or it is neglected at times, the result will be more manure but diminished healthfulness. There can be no hesitation in the choice.

Where the dwelling place contains a garden, the used earth may be put on it, for it is quite probable that even when most, or all of the organic matter, has been driven off, that the chemical changes effected may have liberated potash or soda, etc., in the original soil, thus rendering it more valuable than before to plants.

It may be interesting to know that there is biblical sanction for this method; the Israelites being required to carry out the system whenever they went outside of the camp to ease themselves. (Deut., xxiii: 13.)

It is admitted that this system does not admit of the same public control as the preceding; but it may be made eminently serviceable by those who desire it. It is especially applicable to country houses and smaller villages.

I know of this system being carried out and satisfying the daily wants of from 70 to 100 persons—the room being almost entirely free from odor at all times. If sulphate of lime is added, it fixes the ammonia that would otherwise be driven off, and thus renders the product of some use as a fertilizer.

When epidemics prevail, then in addition to usual methods of sewage disposal, *disinfectants* should be used, as to which see another paper issued by the Board of Health on the subject.

CONCLUSIONS.

In taking a retrospective glance at what has preceded, we cannot but be impressed with the benificence of those laws that tend, in one eternal round, to the purification of what man has made unclean. Foul sewage is thrown into a crystal stream, whose hitherto transparent waters now blush at the pollution. She invokes the aid of the ever constant winds and of the animal and vegetable life she bears in her bosom. They respond, and, in time, she is once more pure and undefiled. The pure water falls from clouds, cleanses our soil and passes into the earth, *foul*, to again issue in wells or springs, generally free from the taint of man's works.

Mother earth condenses gases that oxidize and liberate noxious, waste elements in harmless combinations. We breathe into the air a hurtful gas; but the winds and the rains bear it from us, or the vegetation reaches out its leaves, with their million little mouths, to absorb it and give us in exchange the life-giving oxygen.

Is it asking too much, should Nature call sometimes for man's assistance to expedite results, in order that he may add to his days and happiness? If not, then ponder well on the means that have been proposed to assist nature in her work of purification, and act on them.

It is not intended that the foregoing brief summary of "means" is complete. It was not intended to be, though fundamental general principles, proper to be known at present, it is hoped have been stated clearly and fairly.

Burton says that most men make books like apothecaries make medicine, by pouring from one bottle into another. This one belongs to that class—successful experience has been inculcated rather than novel theories. The solutions used have been standard ones—often huge bottles have been poured from, even the crude materials of the *still* have been obtained and digested before using. Most of the elixirs mixed beautifully, forming clear solutions; others did not, and had to be specially treated to remove the antagonistic elements, whilst others, as my "germ" bottle, would not pour at all scarcely, the fluid being dark and viscid.

The object of such papers as this is to advise the public, who cannot be thinking all the time about sanitary matters, with regard to efficient means of protection against sickness, and especially against epidemics. The county boards of health are looked to as the authorized agents in introducing more effective sanitary measures. But it is well known that such organizations cannot go far ahead of public opinion. We need the aid of the press, the great educators of public opinion, to assist in the good fight for health.

Let some of the systems for the disposal of sewage matters be faithfully carried out simultaneously with a proper attention to ventilation, drainage, water supply, and the general cleanliness of streets and yards, and it is believed that the death rate will be lowered and that epidemics will be almost unknown.

Let every open privy and cesspool be abolished, with their pestilential odors; it follows that the source of contamination of the wells will be gone, and that zymotic diseases will have their usual channels of attack effectually cut off.

Let us, then, advance towards that higher civilization which demands pure air and wholesome water, not simply as a luxury to be enjoyed only on the cool mountain's sides, but as a necessity, to be enforced in city and village by stringent laws and requirements.

SECTION I.

The following table may prove a convenience to those who use cisterns. It gives the capacity of a cylindrical cistern, for one foot in height, and the diameters given, in U. S. liquid gallons (of 231 cubic inches each), the nearest whole number being taken:

DIAMETER. Feet.	CAPACITY. Gallons.	DIAMETER. Feet.	CAPACITY. Gallons.
5	147	15	1,322
6	211	16	1,504
7	288	17	1,698
8	376	18	1,903
9	476	19	2,121
10	587	20	2,350
11	711	21	2,591
12	846	22	2,843
13	993	23	3,108
14	1,151	24	3,384

Multiply these tabular numbers by the height of the cistern in feet to get the capacity of a cistern corresponding to that height.

SECTION II.

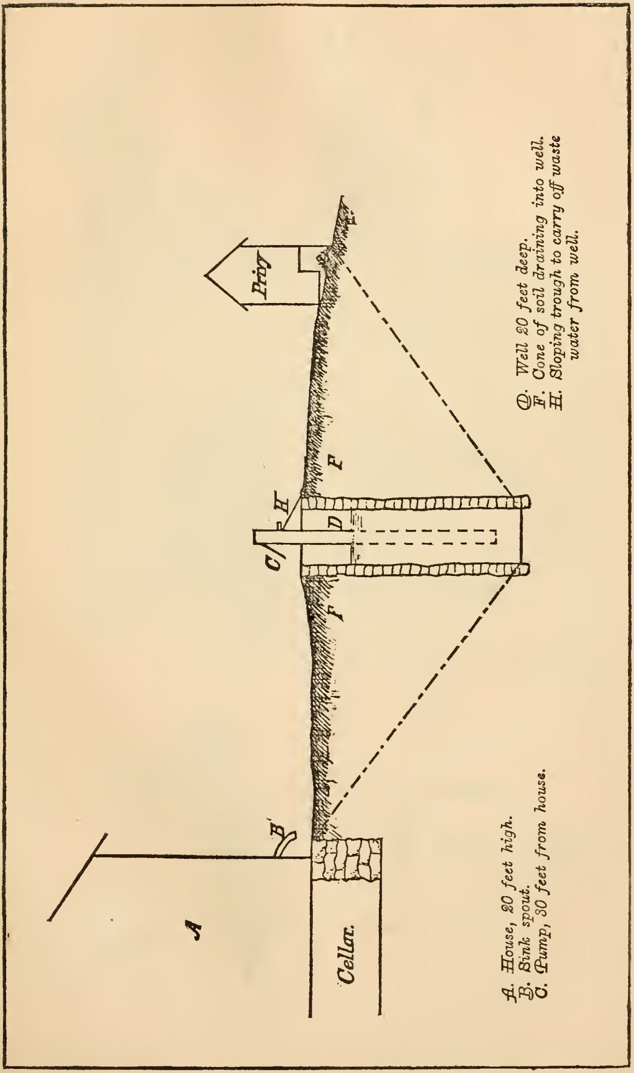
The cuts represent in order the natural drainage from open privies and sinks, into wells that are placed too near them; sections of common privies and sink hole, both polluting the soil around them; and lastly, three plans for privies based upon the dry earth system.

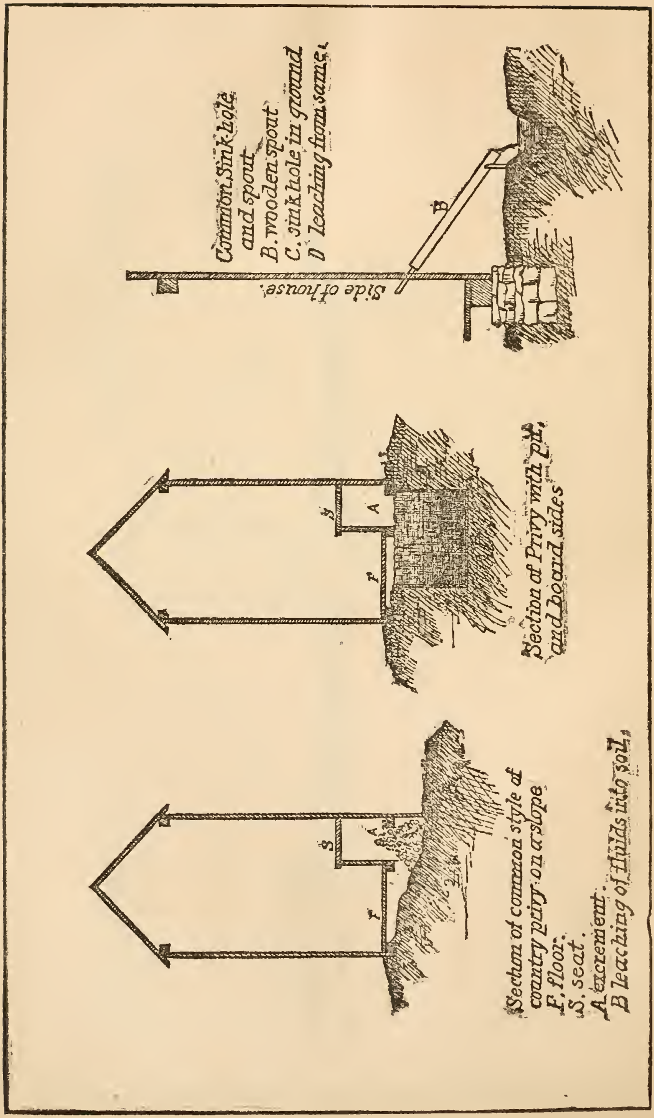
It is to be observed with respect to the latter, that the conditions are simply that the pails used be completely under cover and placed upon a dry foundation, so that no matter from the pails shall ever reach the ground below them, thereby poisoning the air with its effluvia and the wells with its drainage.

It is necessary that the earth, charcoal or ashes be kept in a dry place and under cover, the most convenient place being an apartment just to the rear of the pails, from which it can be readily shovelled into the pails *under* and not *through* the seats as when the ashes, etc., are kept in the privy room proper.

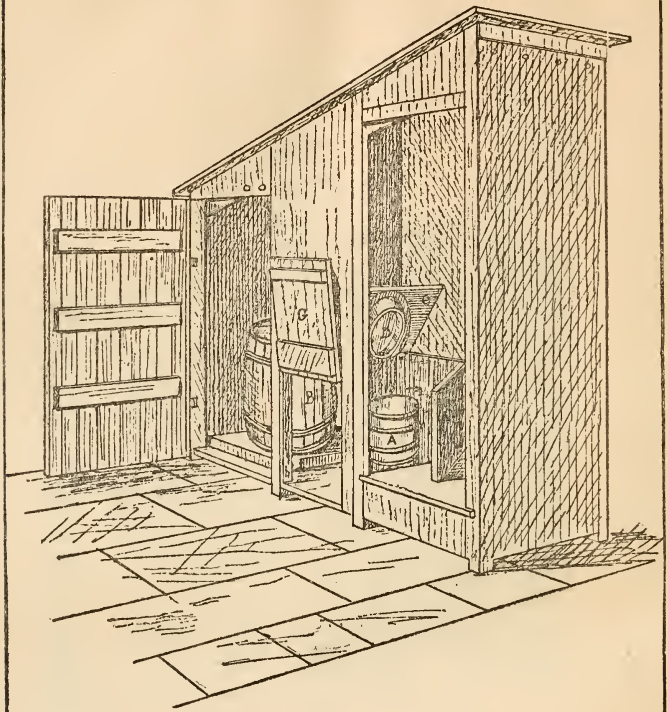
An ordinary open privy can generally be transformed into one closed from the access of rain, by cutting out a space in the weather-boarding of the back, nearly as high as the top of the seats, and replacing this boarding by a door working on vertical or horizontal hinges, as shown in one of the figures. On opening this door, the half barrels or pails can be set under the seats, and every morning charcoal, etc., can be thrown over the contents so as to keep down all odor. The pails should be set upon a plank or stone foundation—at least upon a few blocks or bricks—to elevate them a few inches above the ground, so that water may not reach them. As the pails are filled they should be emptied under a shed and dry earth, etc., strewn over the contents, the action of which in destroying the organic matter has been already explained.

Where wells are at a distance, the contents of the pails might be emptied on cultivated ground for their manure, a slight covering of earth being again used to keep down any odor that might arise.


A
Cellar.
B
C
D
H
F
F
Privy
A. House, 20 feet high.
B. Sink spout.
C. Pump, 30 feet from house.
D. Well 20 feet deep.
F. Cone of soil draining into well.
H. Sloping trough to carry off waste water from well.

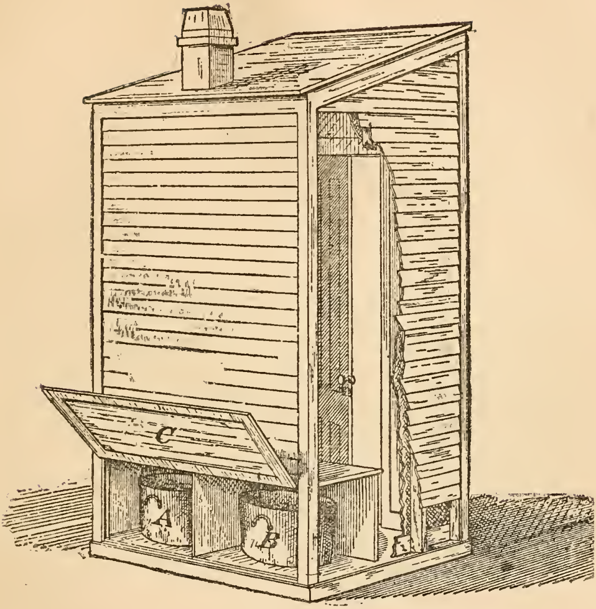

Common Sink-hole and spout.
B. wooden spout.
C. sink hole in ground.
D leaching from same.
Side of house.
Section of Privy with pit, and board sides.
Section of common style of country privy on a slope.
F, floor.
S, seat.
A, excrement.
B leaching of fluids into soil.


Manchester Corporation.
Dry ash closet. Section.
Yard
Screens to separate cinders from ash and direct the latter onto the excrement.



Rochdale Corporation
Pattern Pail closet.

A. excrement pail.
B. ash tub.
C. seat cover (raised)
D iron collar below seat, reaching slightly into pail when cover is down.
F. hinged upright of seat.
G. door admitting from outside to excrement pail.


C
A
B

SECTION III.

The following lucid description of the ventilation of the State Lunatic Asylum of New York, located at Utica, N. Y., is taken, by permission of its author, Dr. John P. Gray, from the "Thirty-sixth Annual Report of the Managers of the State Lunatic Asylum."

It is prefaced by a short extract from the report:

"The managers consider the method of heating and ventilation of the institution to be the safest, most economical, and best. Information is frequently sought as to the system adopted. Recently an application made through the State Department by the British Government for a detailed statement concerning the appliances and method, was referred to Dr. Gray, the superintendent of this institution, who made a report which was submitted to this board before transmission. The managers deem it such a clear and succinct statement of the method adopted, that they embody it as a document worthy of permanent record for use and reference.

Mode of Ventilating and Heating.

1. The mode of ventilation adopted is that of forcing air into the building by the use of two centrifugal fans, a drawing and description of which accompany this communication.

2. The air is delivered from the fans to all parts of the building.

3. First: Into the large channel or basement air duct, or air plenum, which is continuous under the whole building.

4. Second: From this air duct or air plenum, the air passes by flues into the various wards and rooms to be supplied. Each flue is independent; that is, it has an exit at but one point. These flues open into the wards or rooms to be supplied at a point above the level of the top of the windows and doors, so that no air movement caused by opening a window or door will disturb the current of the incoming air. The air is thus distributed uniformly through every part of the building.

5. From the corridors and rooms flues are constructed, starting just above the base-board, each flue passing independently into the attic air chamber. Over part of the building there is ridge ventilation. Over other parts of the building the exit is through ventilators fixed at regular distances.

6. Each fan delivers at each revolution 1,000 cubic feet of air. They can be driven to supply almost any desired quantity. They are here driven night and day, and supply 5,000,000 cubic feet of air per hour, which is a little over 100 cubit feet per minute to each occupant of the house, night and day.

7. The main air duct or plenum is large enough to contain any quantity of air desired, without the need of a rapid current. The area of the flues leading from this duct to the wards and rooms is equal to forty-two inches for each occupant. The exit flues from the wards and rooms to the attic chamber is equal to sixty-four inches for each occupant. the exit area through the ridge ventilation and ventilators equals seventy inches for each occupant.

8. In every single sleeping room there is a flue for the exit of air of sixty-four inches area. In associate sleeping rooms the area of the several flues is equal to sixty-four inches for each occupant. The flues for the supply of air open on the corridors at the height already stated. The sleeping rooms receive the air from the corridors at or near the floor. In some of the wards there is no threshold under the door,

and the doors are shortened at the bottom to allow a space between them and the floor of sixty-four inches area. In some the air enters the sleeping rooms through a register in the bottom rail of the door. In the associate sleeping rooms, where sufficient air could not thus be obtained for several patients, openings are made through the walls at points near the floor. In a few of the rooms for the feeble the flues for the supply of air open into the rooms.

9. This mode secures the most abundant supply of fresh air. It secures what ventilation means practically: that is such constant *dilution* of the body of the air contained in the building by fresh air sent in as to make it for all practical purposes pure.

10. I do not use the words "fresh and foul air flues." In reality, this method secures a constant flow of pure air through the building, from its entrance to its exit, and the gradual enlargement of the areas facilitates the passage and exit of the air, and compensates for the frictional resistance in passing through the building.

11. It is stated in paragraph four that the air is introduced at a height above the doors and windows. While this is undoubtedly best, it is not absolutely necessary to success in ventilation. It is proper to say that in a hospital for the insane, it is advisable to have the air enter above a point where patients would be likely to throw articles into the flues, and also to avoid the evil of patients crowding about the flues and impeding the thorough distribution of the air. In the offices of the institution, in the residence of the officers, and some of the rooms not constantly used in the hospital proper, the air is introduced just above the base-board, and in some instances through the floor; but in all cases, no matter where the air is introduced, the exit flues should start from near the floor as already described. Where the air is thus introduced, it is important to locate the flues so as not to have them opposite windows.

12. Where the rooms are large, as in cases of parlors and sitting rooms, and require two or more flues for the introduction and exit of air, it is important to distribute them so that all parts of the rooms shall be supplied uniformly.

13. Heating is combined with ventilation. The air is warmed to the degree required by being compelled to pass over cast iron radiators, through which steam is circulated on its way from the fan to the occupied parts of the building. These radiators are placed in the main air duct or plenum, and are in separate blocks directly underneath the flues leading from this duct to the occupied parts of the building. There is a box of radiators for each set of three flues, one flue leading to each story. Each block has an independent connection with the main steam pipe, so that each block can be used separately. Each block is cased in on the sides, leaving the bottom open for the free passage of air over the radiators. By this arrangement the air is warmed at the nearest point of its delivery for use, and the heat is not wasted by absorption into the walls of a large general air chamber, and the temperature of the air sent into any special part of the building can be regulated as may be desired, simply by introducing more or less steam into the individual blocks.

14. These radiators are so constructed and connected as to make what is called a "steam coil," and the blocks are so arranged and connected that steam can be turned upon one-third, two-thirds, or the whole, as the atmospheric temperature may require. Of course, there is no impediment to the passage of the air through these blocks for summer ventilation when heat is not needed, as the space between them is sufficient for the passage of the largest volume of air required.

15. This large body of air entering and distributed in the manner described produces no appreciable current. It is not found necessary to raise the temperature of the air introduced higher than 100 degrees at the point of entrance

to the wards and rooms, in order to secure a general temperature of seventy degrees throughout. Thus the air is not rarified, expanded, or dried, to a degree that interferes with healthfulness and comfort.

16. This system does not require registers to control the temperature of the room by closing and unclosing them. The amount of air delivered over each radiating block is warmed to the temperature there required, and as the volume of the air delivered is uniform and constant, thorough ventilation is obtained. Registers in the wards of a hospital would be likely to be used to close off the flow of air if it was too warm, that being easier done than to give information to the engineer having control of the heating blocks. Registers are used in the offices and residences of the officers.

17. It is possible to determine the exact amount of coal necessary to raise a given amount of atmosphere one degree, and this gives the key to the necessary amount of coal to be burned in the steam boilers to raise the whole quantity of air introduced to any desired temperature. The engineer by observing the temperature of the external atmosphere, and knowing the volume of air delivered, can, with sufficient acuracy, supply the necessary amount of heat.

18. To illustrate: The cubic capacity of the wards and rooms of this asylum is, in round numbers, about 5,000,000 feet. Five million cubic feet of air sent in by the fans per hour night and day. Twelve pounds of coal will raise this atmosphere one degree per hour. At this writing the average outside temperature for the past twenty-four hours has been ten degrees below zero. The temperature of the wards has been maintained at from seventy to seventy-two, and we have burned 8 tons and 1,280 pounds of coal, an average of 720 pounds per hour; the actual number of occupants 722.

DESCRIPTION OF FAN.

The fan and its support are of iron, the casing of wood; the rotary or operating part of the fan consists of a shaft with eight radial arms set back on a curve at the extremities of which are fastened iron wind boards, three feet wide and five feet long, in the direction of the axis; the extremities of the wind boards are six feet from the center and consequently describe a circle of twelve feet diameter. The shaft extends beyond the casing and rests on pulley blocks, and on the driving side it is lengthened six feet to receive the driving pulley and remove all obstruction to the easy entrance of air to the fans; the motion is imparted by a belt passing over the pulley, four feet in diameter, with ten-inch face on the end of the shaft, the arms and boards revolve within the wooden casing, the circumference of which instead of being concentric with the shaft, describes a curve of increasing diameter and forms outside the wind boards a channel of constantly enlarging capacity towards the point of delivery. The casing is therefore scroll-shaped, this space being six inches in front and enlarging to three feet at the bottom. The height of the casing from the floor is eighteen feet. The cross-sectional area is equal at the point of delivery to forty-two square feet. The opening in each side of the fan-casing, for the inlet of air, is six feet in area. This whole machinery is placed in a room, the floor of which is on a level with the floor or the main air duct, and the air is admitted through a large open space, double the area of both inlets, and properly guarded.

APPENDIX D.

Table Compiled from the Monthly Bulletin of the North Carolina Board of Health.

Compiled by THOMAS F. WOOD, M. D., Secretary.

TABULAR VIEW, &c., OF ASHE COUNTY.

Months.	Prevailing winds.	Rainy days.	Snow.	Average temp'ature.	Prevailing Diseases.	Diseases of Domestic Animals.	Condition of Public Buildings. Inmates in Poor House.	Cubic space each.	Prisoners in jail.	Cubic space each.	Food served to jail.	Food served Poor House.	No. giving no evid'nce of vaccination.	Conditi'n of wells.	Conditi'n of privies.
Jan.........	n. w.	f	...	......	Measles..........		17	....	8	....	s	s	....	tol.	toler.
Feb.........	n. w.	3	2	38	Pneu'nia, measles, Wh. Cough.	Distemper in horses..	16	....	4	....	g	g	....	g	Imp.
March ...	nw e se	12	2	49	Catarrhal..........	None..........	16	....	5	....	g and s	g and s	....	g	good
April......	w	5	1	58	Whooping Cough, Diarrhœa..	"	19	....	2	....	s	g	....	g	"
May.......	w	9	...	70	Wh. Cough, Diarrh., Dysent'ry	"	20	125	3	....	g and s	g and s	....	g	"
June	w	7	...	71	Diarahœa, Dysentery, Fever...	"	20	....	3	600	"	g and s	None. ..	g	t
July.......	we a n	13	...	68¼	Typhoid Fever, Diarrhœa and Cholera Infantum.........	"	20	....	3	600	"	g and s	"	g	t
August...	e	18	...	78	Typho Fever, Diphtheria..... ...	"	10	....	3	600	"	g and s	"	t	t
Sept.	....	8	..	76	Typho Fever, Diphtheria .. and Catarrhal Fever............	"	19	....	1	600	"	"	....	g	g
Oct....... ...	e a w	5	...	56	Diphtheria and Typhoid Fev.	"	19	627	......	....	"	"	None. ...	tol.	toler
Nov...... .	....	5	...	36	" " " "	....	19	627	......	....	....	....	....	......	....
Dec..	....	...	...	......	....	....		....	......	....	....	....	....	......	....

Population of county 14,443. Population of Jefferson 198.
REMARKS.—No sanitary improvement has been undertaken in Jefferson. In May there was some improvement made in the jail. There are seventy-five school houses of logs and boards. Ventilation good. Water good, but no proper arrangements for privies. Sexes are not separated.

DR. JAMES WAGG, Superintendent of Health.

TABULAR VIEW, &c., OF BURKE COUNTY.

Feb.........			7		Whooping Cough.......		12	1000	6	2500	g	g	2	g	not g
March....	n w	12			Catarrhal and Pneumonia......		12	1000	3	2500	g	g		g	"
May.......		6			Catarr., Diarrhœa, Dysentery	Distemper in cattle..	11	1000	17	880	g	g		g	g

Population of county ...... Population of Morganton ......
No reports as to school houses. No sanitary work done in Morganton.

DR. W. A. COLLETT, Supt. of Health.

APPENDIX D.—*Continued.*

TABULAR VIEW, &c., OF CATAWBA COUNTY.

Months.	Prevailing winds.	Rainy days.	Snow.	Average temperat're.	Prevailing Diseases.	Diseases of Domestic Animals.	Condition of Public Buildings. Inmates in poor house.	Cubic space each.	Prisoners in jail.	Cubic space each.	Food served to jail.	Food served poor house.	No. giving no evidence of vaccinati'n.	Conditi'n of wells.	Conditi'n of privies.
Jan........	....			......	Catarrhal....................	....	17	656	2	1920	s	g	12	p	good
Feb........	w s w	4	1	52	"	....	12	622	12	400	s	s	....	g	"
March ...	s a s w	15		56	"	....	12	656	1	400	g and s	g and s	....	g	toler
April......	s a s w	4		70	Diarrhœa and Dysentery........	None..................	15	656	1	400	s	s	....	g	"
May	s a s w	3		72	" " "	Distemper..................	9	655	1	400	g and s	g and s	....	t	"
June	s a s w	6		79	Bil., Remit., Typhoid Fever...	Distem. amo'g horses	17	626	210	....	s	s	....	t	"
August..	n a s w	12		77	Typho Fever....................	None..................	16	690	3	529	g and s	g and s	None......	g	g
Sept........	n e w	2		68	Typhoid and Malarial Fever	None..................	15	690	1	1100	"	g and s	....	h	t
Oct..	s w e	6		67	" " " "	Epizootic (horses)......	17	627	......	....	"	g and s	....	t	t
Dec.........	w e n e	6	3	......	Typhoid Fever and Pneumon	Epizootic..................	17	....	......	....	g	g	....	g	g

Population of county 15,000. Population of Newton 600.

Remarks.—The report of sanitary work in Newton shows that in all the months, except Jan., September and October, it was prosecuted.

There are fifty-two school houses, logs and frame, with good ventilation and water, adequate privy arrangements, and the sexes are separate.

Dr. J. R. Campbell, Superintendent of Health.

TABULAR VIEW, &c., OF CLEVELAND COUNTY.

Months.	Prevailing winds.	Rainy days.	Snow.	Average temperat're.	Prevailing Diseases.	Diseases of Domestic Animals.	Inmates in poor house.	Cubic space each.	Prisoners in jail.	Cubic space each.	Food served to jail.	Food served poor house.	No. giving no evidence of vaccinati'n.	Conditi'n of wells.	Conditi'n of privies.
Jan........	s	3	...	......	Whooping Cough, Catarrh,....	Hog cholera..............	12	....	11	....	g	g	22	g	not g
Feb.	s a s w	4	2	......	Wh. Cough, Catarrh, Pneu'nia	None..................	11	....	10	....	g	g	....	......	....
March ...	s a s e	17	...	......	Catarrh, Pneu'nia, Wh. Cough	None..................	11	....	10	....	g	g	....	g	good
May.......	s a s e	3	...	......	Catarrhal and Dysentery........	Hog cholera..............	9	....	10	....	g	g	....	......	....
June......	s w	1	...	......	Bil. Remit Fever, Dysentery	None..................	9	....	3	....	g	g	....	g	bad
July.......	s a s w	5	...	......	Remittent Fever..................	None..................	10	....	3	....	g	g	....	g	g
Sept	s e	...	...	......	Typho, Mal., Remit. Fever, Dysentery and Pneumonia	None..................	11	....	4	....	g	g	....	g	g
Oct...	ne a s w	2	...	......	Typo Malarial........................	None..................	10	....	4	....	g	g	....	g	g
Nov.	....	21	...	......	....	....	....	....	1	....	g	g	....	g	g
Dec.........	....	20	2	b.z.	....	....	11	....	3	....	g	g	....	g	g

Remarks.—No sanitary work or improvement of public buildings reported since January. There are ninety school houses of logs and boards. The ventilation and water supply are good.

Dr. J. C. Gidney, Superintendent of Health.

TABULAR VIEW, &c., OF BUNCOMBE COUNTY.

May.	s e	7	...	72	Diarrhœa and Dysentery	None	15	...	13	7608	g	g	...	g	g
June	n e	8	...	65	" " "	"	15	...	13	7608	g	g	...	g	g
July	s e	12	...	68	Diarrhœa, Dysentery and Typhoid Fever	"	15	...	12	7608	g	g	...	g	g
August	e	12	...	67	Typh., Bil. Fever, Diarrhœa and Chol. Infantum	"	15	...	12	7608	g	g	None	g	t
Sept.	n e	5	...	65	Dysentery and Billious Fever	"	15	...	12	7608	g	g	"	g	g
Oct.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Nov.	n e	6	...	50	Influenza and Bronchial	Distemper	16	...	30	7608	g	g	...	g	g

Population of Buncombe county ...... Population of Asheville ......

REMARKS.—In June, September and November the drainage of the streets was looked after. In May and September efforts were made towards improving the sanitary condition of Asheville.

There are eighty-six school houses in the county. The ventilation and drinking water, and privy system are good.

DR. W. L. HILLIARD, Superintendent of Health.

TABULAR VIEW, &c., OF CABARRUS COUNTY.

Feb.	sw nw	...	...	55	Catarrhal and Typho	...	15	1296	1	3375	s	s	...	g	good
March	"	...	...	60	" " Pneumonia	None	13	1296	1	3375	s	s	...	g	"
April	w a s w	...	...	65	Diarrhœa, Catarrhal and Intermittent Fever	None	13	1296	2	3375	g and s	g and s	...	g	"
May	s s w w	...	...	78	Typhoid Fever, Diarrhœa and Dysentery	None	11	1296	...	3375	...	g and s	...	g	"
July	"	s	...	76	Billious, Remit., Typho Fever and Chol. Infantum	Con of brain in hor's	15	1296	4	3375	g and s	g and s	...	g	"
Sept.	"	s	...	75	Diarrhœa and Mal. Fever	None	15	1296	3	3375	g and s	g and s	None	g	t

Population of county 14,961. Population of Concord 1,262.

REMARKS.—In March and May some sanitary duty was performed in Concord.

There are fifty-four schools of logs and boards, of which the ventilation, water and privy arrangements are good.

DR. F. M. HENDERSON, Superintendent of Health.

TABULAR VIEW, &c., OF COLUMBUS COUNTY.

Jan.	n and s	5	1	50	Catarrhal	...	6		8		g	g		g	toler.
Feb.	s	4		60	Meas. Influenza. Wh. Cough	...	9		7		g	...		g	"
April	s	5	1	60	Sore-throat and Fever	None	5		6		1365	...		g	"

Population of county 8,474. Population of Whiteville 500.

REMARKS.—There was some drainage done in Whiteville in February, but otherwise no sanitary work. The report of school houses is not made.

DR. M. R. MORRISON, Superintendent of Health.

APPENDIX D.—*Continued.*

TABULAR VIEW, &c., OF CUMBERLAND COUNTY.

Months.	Prevailing winds.	Rainy days	Snow.	Average temperat're	Prevailing Diseases.	Diseases of Domestic Animals.	Condition of Public Buildings: Inmates in Poor House.	Cubic space each.	Prisoners in jail.	Cubic space each.	Food served to jail.	Food served Poor House.	No. giving no eviden'e of vaccinati'n	Conditi'n of wells.	Conditi'n of Privies.
Jan.	n	8	..	52¼	....	None	10	....	18	....	p and s	p and s	....	g	fair
Feb.	....	...	...	......	None	"	13	800	11	1000	g and s	g and s	5	g	"
March	....	...	...	......	Measles and Whoop. Cough	"	19	1000	5	800	g and s	g and s	....	g	"
April	s a s e	4	1	63	....	"	16	800	3	1000	g and s	g and s	4	g	"
May	s a s w	4	...	74	....	"	10	1000	4	800	g	g	....	g	"
June	....	...	...	......	Very little of any kind	"	16	1000	4	800	g	g	....	g	"
July	....	...	...	......	" " "	"	17	1000	4	800	g	g	....	g	"
August	....	...	..	......	....	"	14	1000	4	900	g	g	3	g	"
Oct.	....	...	...	......	Malarial	Epizootic	16	1000	15	800	g	g	6	g	"
Nov.	n n w	...	..	55	"	....	15	....	6	....	g	g	2	g	"

Population of county 25,000 Population of Fayetteville 5,000.

Remarks.—Sanitary work has gone on in Fayetteville during the entire year, and the public buildings are reported in good order. There are seventy-five school houses, log and frame. The ventilation and water are good. There is no adequate arrangement, and the sexes are not separate.

Dr. O. P. Robinson, Superintendent of Health.

TABULAR VIEW, &c., OF DUPLIN COUNTY.

Months.	Prevailing winds.	Rainy days	Snow.	Average temperat're	Prevailing Diseases.	Diseases of Domestic Animals.	Inmates in Poor House.	Cubic space each.	Prisoners in jail.	Cubic space each.	Food served to jail.	Food served Poor House.	No. giving no eviden'e of vaccinati'n	Conditi'n of wells.	Conditi'n of Privies.
Jan.	Varia.	7	...	50	Catarrhal	None	7	2000	5	425		g and s	....	g	g
Feb.	s w	3	1	63	Pneumonia and Catarrhal	....	5	2000	3	500	g and s	....	8	....	....
March	swt n w	14	1	62	" " Malarial Fev	None	4	2500	.....	....	c and s	....	....	g	g
April	s w	8	...	62½	Malarial and Catarrhal	Distm'er am'g horses	4	2500	.....	....	c and s	....	....	g	g
May	s s w	2	..	87	Malarial Fever and Diarrhœa	None	6	2000	1	850	g and s	....	....	g	g
June	Varia.	5	...	90	Malarial Fever	"	7	2500	5	900	c and s	c	....	g	g
July	s	13	...	90	{Billious and Typhoid Malarial Fever	"	7	2500	8	400	e	c and s	....	g	g
August	s	s.	...	89	Malarial and Typhoid Fever	"	8	2500	5	900	c and s	c and s	....	g	g
Oct.	Varia.	2	...	......	{Malarial and Typhoid Malarial	"	....	2500	.....	900	g	g	....	g	g
Nov.	....	11	1	50	Catarrhal	....	8	......	5	....	g	g	....	g	g

Population of county 18,000. Population of Kenansville 400.

Remarks.—No sanitery work done. Improvements in public buildings during the year. The number of school houses not reported but their condition as to ventilation, water supply and privies reported good.

Dr. J. D. Roberts, Superintendent of Health.

TABULAR VIEW, &c., EDGECOMBE COUNTY.

January	n n e, s s e.	10	1	45	Pulmonary and Intestual.		50	1440	7	5622	s	s	50	g	g
Feb.	n&ne &se.			60	Pneumo'ia, Dysentery, Mal. and Cat'al Fevers.		51	5000	5	326	c		56	g	g
March	sw & n	15		70'8	Bronchites and Pneumonia,	None	49	5000	8	326		c	49	g	g
April	s & se.	8	1	68	Bronchites, Dys'tery, Measles.	None	50		2		s	s	none	g	g
May.	n & n w s.	1		74	Intermit. Fever, Diarrhœa and Dysentery.	None	49		6		w	w	49	g	g
June	s s e.	5		90	Measles, Cont. Fever, Roseola, Whooping Cough.	None	48		6		w	w		g	g
July	s & s w.	11		78⅔	Remit. Fever and Measles.	None	48		7					g	g
August	s & se n& ne	13		80	Typh'd, Bil. and Remit. Fev'r.	None	38		3					g	g
Sept	n& ne s&se			68	Typh., Inter. and Re'it. Fev'r.	None	41		5					g	g
Oct.	n nes	5		60	Pneumonia, Bronchitis. Typhoid and Intermit. Fever.	Epizootic (horses)	48		6					g	g
Nov	n ne se	17	1	48	Pleu'sy, Neumon, Mala'l Fev.	" "	50		10	640				g	g
Dec.	n ne	10	2	43	Neumon, Pleu'sy, Bronchites.	Epizootic	40		13	*				g	g

Population of county 25,000. Population of Tarboro 2,000.

REMARKS.—During the year, except in May and October, sanitary work of some sort was going on. In January, June, August and September there were improvements made in public buildings.

There are fifty-six school houses, frame and log, and the ventilation, water supply and privy arrangements are reported good.

* Two cells, 8x10.

DR. A H. MCNAIR, Superintendent of Health.

TABULAR VIEW, &c., OF GASTON COUNTY.

Jan		s	1	60	Diphth., Pneumo., Bronchit's	Pleuro Pneumania	6	515	2		f	f	8	g	poor
Feb	s	s		60	Catarrhal, mild Scarlatina		7		3						
March	s s w	s		60	Ditto and Influenza		7		3						fair
May	s w	3		65	Dysentery with Mal. Diseases		8		7						
June															
July	s w	6		80	Typho. Mal. with Dental Fev.	None	10		8		f	f		g	t
August	s w	12		65	Malarial Fevers	None	10		15					f	f
Sept	s w	..		70	" "	None	11		17					f	fair

Population of county 11,500. Population of Dallas 420.

REMARKS.—No sanitary work done in Dallas for the year, and no improvement in public buildings.

Seventy-four school houses reported, log and frame, with tolerable ventilation and fair drinking water.

DR, E. B, HALLAND, Superintendent of Health,

APPENDIX D.—*Continued.*

TABULAR VIEW, &c., OF GRANVILLE COUNTY.

Months.	Prevailing Winds.	Rainy Days.	Snow.	Average Temp'ture.	Prevailing Diseases.	Diseases of Domestic Animals.	Condition of Public Buildings: Inmates in Poor House.	Cubic Space each.	Pris'n'rs in Jail.	Cubic Space each.	Food Served to Jail.	Food Served Poor House.	No. giving no evid'nce of Vaccination.	Condit'n of Wells.	Condit'n of Privies.
Feb........	se & n e	12	...	59°	Rubeola and malarial fever, catar'l fev. and whoop. c'gh.	Stomatitis distemp'r	20	15,000	2	500	c and s	s	13	g	bad
March....	s e & s	10	...	61	Pneumonia, rubeola and whooping cough.	Stomatitis in Sasses.	21	15,000	3	"	s	s	13	"	good
April......	s & n e	4	1	50	Whooping cough, measles, pneumonia and rubeola.	Epizootic among Horses.	21	15,000	5	"	s	g and s	16	"	g
June	s & e	...	...	83	Dysentery, measles and whooping cough.	None.	21	10,000	4	5,000	s	g	21	b	fair
July	s w & s	...	...	90	Malarial, tyhpho, pneumonia and dysentery.	"	19	5,000	5	500	g and s	g and s	14	g	g
August...	w s	10	...	91	Typho remittent and Intermittent fever.	"	19	Unli	6	"	g and s	g and s	12	fair	b
Sept'ber	w n w	...	...	86	Remit., typho and mal. fev'rs	Chicken cholera.	19	Unli.	8	1,500	s	s	5	g	b
October	w n w	4	...	62	Intermittent and remittent fevers, neuralgia, &c.	Epizootic (horse).	5	800	1	1,500	....	....	2	g	g
Nov'ber	s e s e	15	1	52	Intermittent fev., pneumonia	Epizootic and chol'ra	19	5,000	6	10,000	g	g	6	......	b
Dec'ber.	n w	6	3	40	Pneumonia, diptheria.	Epizootic.	19	....	3	1,800¼	g	g	3	......	b

Population of county 31,049. Population of Oxford 1,339.

Sanitary improvement was commenced in February, and with the exception of October continued through the year. The public buildings were in satisfactory condition.

Eighty-nine school houses are reported, with good ventilation and good water, but with inadequate privy arrangements.

DR. J. B. WILLIAMS, Superintendent of Health.

TABULAR VIEW, &c., GREENE COUNTY.

Jan.........	s w	4	...	60°	Malarial fever and measles.	....	1	1,728	8	144	good	good	2	g	fair
Feb.........	s w	4	1	65	Measles and catarrhal fever.	Lung fev. am'g hors's	....	....	1	....	....	....	....	g	fair
March ...	s w & e	11	...	65	Morbilli and pertussis.	....	2	....	1	....	....	....	....	g, s	fair
April......	s & s w	10	...	67	Diarrhœa and dysentery.	....	2	....	1	....	....	....	3	g	fair
May........	s w	...	...	77	Dysentery.	....	2	....	3	....	g and s	g and s	3	fair	....
June	s w	6	..	88	Remittent fever and pertussis	None.	2	....	3	30	good	good	3	g	fair
July........	....	...	...	....	....	....	....	....	....	....	....	....	....	....	....
August..	s w	12	...	80	Intermittent and remit. fev'rs	None.	2	800	4	400	g and s	g and s	1	g	good
Sept........	sw & n e	...	...	81	Remittent, intermitt'nt and typo-malarial fevers.	....	4	600	6	400	g and s	g and s	4	g	good
Oct	n & n w	6	...	70	Remittent, intermitt'nt and typo-malarial.	Epizootic.	5	800	1	1,600	....	....	2	g	good
Nov........	n e	8	...	62	Remit. and intermittent.	....	5	"	1	"	good	good	2	g	good
Dec.........	....	...	...	....	....	....	....	....	....	....	....	....	....	....	....

Population of county, 10,044. Population of Snow Hill, 369.

REMARKS.—No drainage for sanitary purposes was done in Snow Hill for the year, but general sanitary improvements were made in January, April and September. The public buildings were improved in January, March and October. There are 42 school houses reported, frame and log, ventilation and water good, and privy arrangements good; sexes separate.

DR. W. C. GALLOWAY, Superintendent of Health.

TABULAR VIEW, &c., GUILFORD COUNTY.

Jan.........	n & n e	3	...	50°	Chicken pox, measles and malarial fever.	....	40	....	13	....	c and g	c and g	....	g	good
Feb.........	e & s	5	2	50	....	Distem. and hog chol.	....	....	....	....	g and s	g and s	....	g	"
March....	n & e	...	...	48	Catarrhal.	" "	39	....	....	....	....	c and s	....	tol.	"
April......	n & w	6	1	70	Mild malarial and catarrhal.	Distemper in Horses.	38	....	19	....	s	s	some......	f	"
May.	s & s w	4	...	77	Dysentery, diarrhœa, malarial fever.	Horse distemper and hog cholera.	37	....	26	....	c and s	c and s	m	f	f
June	s & w	6	...	86	" " "	Chicken, hog chol'ra.	26	....	29	....	g and s	g and s	....	g	f
July.......	s & w	10	...	86	Malarial and intermit. fevers.	None........	24	....	21	....	g	g	....	f	g
August...	s,n&n e	13	...	78	Malarial fever.	"	30	s	20	s	g and s	g and s	....	f	g
Sept........	n & w	...	...	76	Malarial fevers and catarrhal.	"	32	....	10	....	c and s	c and s	....	g	f
Oct.........	....	...	...	....	....	....	....	....	....	....	....	....	....	....	....
Nov.	ne&nw	14	1	48	Catarrhal.	Hog cholera........	31	....	13	....	g	g	....	g	fair
Dec.........	n & e	7	3	42	Pulmonary.	" "	36	....	20	....	....	g	....	g	fair

REMARKS.—Sanitary work has been carried on in Greensboro the year through, except in December, and the public buildings are reported in good sanitary condition. The number of school houses is not reported. The material is logs, frame and brick. The ventilation is good, drinking water good, and in most cases the privy arrangements are satisfactory. DR. ED. LINDSAY, Supt. of Health.

APPENDIX D.—*Continued.*

TABULAR VIEW, &c., HAYWOOD COUNTY.

Months.	Prevailing Winds.	Rainy Days.	Snow.	Average Temp'ture.	Prevailing Diseases.	Diseases of Domestic Animals.	Condition of Public Buildings. Inmates in Poor House.	Cubic Space each.	Pris'n'rs in Jail.	Cubic Space each.	Food Served to Jail.	Food Served Poor House.	No. giving no evidence of Vaccination.	Condit'n of Wells.	Condit'n of Privies.
May	s w	7	...	58°	Whoop. cough and pneumn'ia	None	25	8,000	2	...	good	good	...	g	not g
August	s	f	...	65	...	"	...	...	3	101	com'n	...	...	g	good
Oct.	w	f	...	58	...	"	...	...	4	1,071	g and s	...	...	g	good
Nov.	...	...	...	50	Fever.	Epizootic.	21	...	5	240	good	good	...	g	med
Dec.	s	...	7	25	Catarrhal rheumat.	...	...	...	3	...	...	...	...	...	fair

Population of county 10,263. Population of Waynesville 246.
No sanitary improvement has gone on in Waynesville. Fifteen school houses are reported, and in a satisfactory sanitary condition.

DR. G. D. S. ALLEN, Superintendent of Health.

TABULAR VIEWS, &c., HALIFAX COUNTY.

Months.	Prevailing Winds.	Rainy Days.	Snow.	Average Temp'ture.	Prevailing Diseases.	Diseases of Domestic Animals.	Inmates in Poor House.	Cubic Space each.	Pris'n'rs in Jail.	Cubic Space each.	Food Served to Jail.	Food Served Poor House.	No. giving no evidence of Vaccination.	Condit'n of Wells.	Condit'n of Privies.
Jan.	n	8	2	50°	Catarrathal.	...	30	3,220	21	22,500	s	s	31	...	...
Feb.	s w	4	1	48	Disease of lungs and roseola.	...	43	3,220	13	22,500	s	s	25	...	...
March	n	10	...	50	Pulmonary and malarial.	...	38	3,220	6	22,500	...	...	17	...	...
April	s & w	5	...	64	Malarial and dysentery.	...	38	3,220	7	22,500	s	s	17	soft	good
May	s	2	...	75	Diarrhœa and dysentery.	...	38	3,220	6	22,500	s and g	s and g	21	soft	good
June	s & w	11	...	80	Dysentery and cont. fever,	None.	38	3,220	...	...	...	s	14	g	good
July	s	15	...	81	Typhoid and typho mal. fev'r	"	26	5,220	6	22,000	s	s	13	g	good
August	s	12	...	77	Diarrhœa, typho and mal. fevers of a mild type.	"	26	3,220	11	22,500	s	s	...	g	good
Sept.	n & w	3	...	72	Typho and malarial fevers.	"	26	s'f'nt	6	suffi'nt	g and s	g and s	14	g	good
Oct.	n & w	3	...	48	Malarial (mild).	...	26	"	8	"	s	s	...	g	good
Nov.	n & w	11	...	45	...	...	26	...	8	1,071	...	...	...	...	...
Dec.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Population of county, 30,289. Population of Halifax, 476.

REMARKS.—Sanitary work and improvement in public buildings were commenced in April and continued until November. There are 40 school houses, frame and logs, ventilation and water good, and privy arrangements good, sexes separate.

DR. ISAAC E. GREEN, Superintendent of Health.

TABULAR VIEW, &c., OF HENDERSON COUNTY.

Jan	...	f	...	...	...	...	...	...	...	...	s	s	...	g	good
Feb	...	f	1	...	Measles and Mumps	...	16	...	6	...	s	s	...	g	"
March	s w a n	..	...	...	...	...	16	...	6	...	s	s	...	g	...
April	s e a w	s	...	...	...	...	6	...	4	...	s	s	...	g	...
May	s e a w	s	...	...	...	None	6	...	10	...	s	s	...	g	...
June	s e a w	f	...	78	...	"	13	...	9	...	s	s	...	g	none
August	s and e	s	..	...	...	"	14	...	9	...	g and s	g and s	...	g	none

Population of county .... Population of Henderson ....

REMARKS.—No sanitary work of public character in county town. Fifty school houses of logs and boards, with good ventilation, good drinking water, but no provision for privies.

DR. J. L. EDGERTON, Superintendent of Health.

TABULAR VIEW, &c., OF IREDELL COUNTY.

Jan	e	8	...	46	Pneumonia and Rheumatism	None	20	...	13	...	g	g	...	g	poor
Feb	e	...	...	...	None	...	20	...	8	...	g	g	...	g	good
March	e	17	...	49	...	...	18	Not limited.	5	240	s and g	s and g	...	g	toler
April	e	11	1	50	Diarrhœa	None	18		2	240	s and g	s and g	...	g	"
May	w	4	..	70	Wh. Cough, Diarrh'a, Dys'try	"	19		2	240	s and g	s and g	...	g	"
June	s and w	8	...	75⅚	Billions, Intermittent Fev. / Sum'r compl't with children	"	19		5	240	g	g	...	g	"
July	s	10	...	78	...	"	19		5	240	g and s	g and s	...	g	"
August	s	9	...	75⅓	None	"	20		6	240	g and s	g and s	...	s	"
Oct	e	6	...	65	Bil. and Remit. Fever	Epizootic	18		...	240	g and s	g and s	...	g	t
Nov	n	10	...	44	Bronchial	"	21		5	240	g	g	...	g	med.

Population of county .... Population of Statesville ....

REMARKS.—Very little sanitary work has been done in Statesville of a public character. There are eight log and four brick school houses, well ventilated, privies are provided but the sexes are not separate.

DR. THOS. E. ANDERSON, Supt. of Health.

APPENDIX D.—*Continued.*

TABULAR VIEW, &c., OF JOHNSTON COUNTY.

Month.	Prevailing Winds.	Rainy days.	Snow.	Average temperat're	Prevailing Diseases.	Diseases of Domestic Animals.	Condition of Public Buildings. Inmates in poor house.	Cubic space each.	Prisoners in jail.	Cubic space each.	Food served to jail.	Food served Poor House.	No. giving no evid'nce vacination.	Conditi'n of wells.	Condition of privies.
Jan.	...	...	...	50	Measles	None	7	900	3	600	s	s	...	...	...
Feb.	s a s w	3	...	50	Measles and Pneumonia	...	7	900	4	600	s	s	...	g	...
March	s sw w	12	...	56	Measles and Wh'ping Cough	...	6	1200	3	1500	s	s	...	g	bad
April	s a se	2	1	62	Meas., Bronchitis, Wh. Cough	None	6	1200	3	1500	s	s	...	g	bad
June	s a sw	1	...	...	Inter and Remit Fever.	"	7	1200	5	1500	s	s	...	g	b
July	s a sw	6	...	...	...	"	6	1600	5	1200	s	s	...	g	b
August	s a sw	5	...	90	Malarial Fever	"	6	1600	5	800	s	s	...	g	b
Oct.	...	..	...	...	Typo Malarial Fever	"	10	1200	4	800	s	s	...	g	b
Nov.	n nw	16	1	...	...	...	...	1200	...	800	...	...	...	...	...
Dec.	n w s	10	4	32	One case Typhoid	...	6	1600	3	1200	g	...	...	...	...

REMARKS.—No sanitary work done in Selma except in January and December. The number of school houses not given. The ventilation is good, drinking water good, privies not in good order.

DR. R. J. NOBLE, Superintendent of Health.

TABULAR VIEW, &c., OF LINCOLN COUNTY.

Month.	Prevailing Winds.	Rainy days.	Snow.	Average temperat're	Prevailing Diseases.	Diseases of Domestic Animals.	Inmates in poor house.	Cubic space each.	Prisoners in jail.	Cubic space each.	Food served to jail.	Food served Poor House.	No. giving no evid'nce vacination.	Conditi'n of wells.	Condition of privies.
Jan.	n a n e	1	...	45	Pulmonary and Wh. Cough	None	...	...	...	...	g	g	...	...	...
Feb.	s a n e	3	1	54	Catarrhal	...	7	1200	...	...	g	g	...	g	toler
March	n a n w	12	...	50	...	...	7	1200	2	...	g	g	...	h	...
April	s a n w	5	1	65	Dysentery, Cholera Morbus	None	7	1280	3	...	g	g	...	h	...
May	s w	1	...	85	Dysen'y, Ulc. Mem. Stoma'tis.	None	7	1200	4	...	g	g	...	h	...
June	n w	2	...	85	Dysentery, Typho. Mal. Fever.	Chicken Cholera	8	1200	3	...	g	g	...	h	...
July	s w	4	...	88	Enteric and Remit. Fever	None	6	...	4	...	g	g	...	h	...
August	ne a se	8	...	88	Malarial	None	7	...	6	...	g	g	...	h	...
Sept.	s a se	5	...	85	Malarial Fever	None	9	...	6	...	g	g	...	h	...
Oct.	s w	3	...	72	...	...	8	...	6	...	g	g	...	h	...
Nov.	ne a se	12	...	55	...	Murrain & Epizo'ty	8	...	6	...	g	g	...	h	...
Dec.	n w	5	2	49	...	...	7	...	8	...	...	...	...	...	...

REMARKS.—The sanitary condition of Lincolnton did not require public work, and the public buildings are in good condition. There are fifty-three public school houses, well ventilated and properly provided with drinking water and privies.

DR. J. M. LAWING, Superintendent of Health.

TABULAR VIEW, &c., OF MACON COUNTY.

Feb	s a s w	1	...	...	Bronchitis, 40 cases Mumps	...	...	...	1	...	g	g	...	g good
March	s	...	...	...	Colds	...	...	...	2	...	g	...	...	g good
April	...	...	...	...	Catarrhal	None	...	...	...	...	g	g	...	g good
May	s	6	...	...	Diarrhœa and Dysentery	"	...	...	1	...	g	...	...	... ...
July	n w	2	...	...	Dysentery and Typhoid Fev	"	...	...	7	...	...	...	...	g g
August	s & e	16	...	...	Fevers, Disorder of Digestion	"	15	...	6	...	g	g	...	s b
Sept	s w	6	...	...	Pneumonia, Bron., derangement of liver in children	"	15	...	6	3000	g	g	6	t b
Nov	s w	8	...	...	Lungs and Inflammatory	Epizooty	...	...	4	...	g	...	3	m b

Population of county .... Population of Franklin ....

REMARKS.—There has been no attention given to sanitary condition of Franklin. There are twenty-five school houses in the county well provided as regards ventilation, water and privies.

DR. J. M. LYLE, Superintendent of Health.

TABULAR VIEW, &c., OF MECKLENBURG COUNTY.

Feb	s w	6	1	49	Pneumonia and influenza	...	32	500	32	288	s	s and c	...	g	...
March	n e	18	...	79	Catarrhal	...	27	500	19	288	s	s and g	...	g	...
April	...	...	...	...	...	...	30	500	15	288	s	s and g	...	g	b
May	s	6	...	71.7	Diarrh'a, Dysen'ry, Bil. Fever	Chicken cholera	26	500	11	288	g and s	g and s	...	g	g
June	s w	11	...	76.6	" " " "	Hog cholera	26	...	17	...	g and s	g and s	...	g	g
July	s w	17	...	...	...	None	26	...	27	...	s	s	...	g	g
August	n e	10	...	76⅓	Catarrhal	Chicken cholera	24	...	13	...	g and s	g and s	...	g	g
Sept	s w	10	...	69	Inter. and remit fever	None	27	...	13	...	g and s	g and s	...	g	g
Oct	n e	7	...	59	Typo, mal., inter., Remit fev.	Chicken cholera	30	...	19	...	g and s	g and s	...	g	g
Nov	...	16	...	45	Diphtheria	...	30	...	11	...	...	...	...	g	pass.
Dec	s w	14	3	38	...	...	30	...	23	...	g	g	...	g	fair

Population of county 34,100.

REMARKS.—Sanitary work was done in Charlotte in January, February, March, April and May, and some improvements in public buildings in January and February. The number of school houses is not given, but are of logs, frame and brick, well ventilated and supplied with water, but with no privy accommodations.

DR. H. M. WILDER, Superintendent of Health.

APPENDIX D.—*Continued.*

TABULAR VIEW, &c., OF MONTGOMERY COUNTY.

Months.	Prevailing Winds.	Rainy Days.	Snow.	Average Temp'ture.	Prevailing Diseases.	Diseases of Domestic Animals.	Condition of Public Buildings. Inmates in Poor House.	Cubic Space each.	Pris'n'rs in Jail.	Cubic Space each.	Food Served to Jail.	Food Served Poor House.	No. giving no evidence of Vaccination.	Condit'n of Wells.	Condit'n of Privies.
April	...	...	...	...	...	...	12	...	2	...	s and g	s and g	...	...	...
May	...	...	...	...	...	...	12	...	...	...	...	g and s	...	...	...
June	...	...	...	...	...	...	12	...	2	...	g and s	g and s	...	...	...
August	s a s w	f	..	80	None	None	12	...	...	...	...	...	g	g	t
Sept	s a s w	f	...	85	Malarial fever, diphtheria	"	12	...	8	...	g and s	g and s	...	g	g
Oct	variab	3	...	60	Billious fever, diphtheria	"	11	...	...	3	g	g	...	g	g
Nov	...	7	...	60	Rheumatics, malarial	Epizooty	11	...	...	...	g	g	...	...	...
Dec	variab	7	3	...	...	"	11	...	1	...	g	...	...	g	g

Remarks.—No sanitary work in Troy. No report of number of school houses given, but they are well ventilated and provided for with good water and proper privies.

Dr. W. A. Simmons, Superintendent of Health.

TABULAR VIEW, &c., OF NASH COUNTY.

Months.	Prevailing Winds.	Rainy Days.	Snow.	Average Temp'ture.	Prevailing Diseases.	Diseases of Domestic Animals.	Inmates in Poor House.	Cubic Space each.	Pris'n'rs in Jail.	Cubic Space each.	Food Served to Jail.	Food Served Poor House.	No. giving no evidence of Vaccination.	Condit'n of Wells.	Condit'n of Privies.
Feb	...	...	...	...	Few cases of Roseola	...	28	...	5	...	g	g	...	...	...
March	...	11	...	...	Catarrhal	...	26	...	4	...	s and g	s and g	...	g	...
April	variab	2	1	48½	Pulmonary, malarial	...	27	500	6	1000	s and g	s and g	30	g	none
May	s sw ne	2	...	61⅔	Malari'l, diarrhœa, dysentery	...	26	500	6	800	g and s	g and s	20	g	"
June	s w	7	...	67½	Inter., remit., typhoid Fever, diarrhœa	None	26	500	7	800	g and s	g and s	33	g	"
July	s w n e	7	...	71	Typhoid, malarial fever	"	26	unlim'd	5	unlim'd	g and s	g and s	30	g	t
August	s w n e	12	..	70	Malarial fevers	"	25		5		g and s	g and s	29	g	t
Sept	s w s e	2	...	60	" "	"	25		4		g and s	g and s	25	g	t
Oct	n e	3	...	48⅓	Mal. fever, whooping cough	"	26		4		g and s	g and s	26	g	t
Nov	s w	12	1	40	Intermittent, tonsilletis	...	25		5		g and s	g and s	5	g	t

Remarks.—Sanitary work was done in July and August, and improvement in public buildings in April. There are seventy school houses with good ventilation and good drinking water.

Dr. R. A. Sills, Superintendent of Health.

APPENDIX D.—*Continued.*

TABULAR VIEW, &c., OF NEW HANOVER COUNTY.

Jan........	n	9	...	55 3	Influenza, whooping cough....	None	25	....	20	....	....	....	....	......	....
Feb...	s w	7	...	53.3	Whooping Cough.....................	"	34	....	17	288	s	....	....	n g	n g
March ...	s w	14	....	56.2	" "	"	42	....	9	288	g and s	g and s	15	g	impe
April	s w	10	....	63.5	" "	....	40	....	15	....	s and g	s and g	n	g	f a i
May..... .	s	5	....	70.9	Wh. cough, Diarrhœl diseases	None.....................	41	....	16	....	g and s	g and s	....	g	t
June.....	s w	10	...	76.6	" cholera infantum	"	40	....	6	....	g and s	g and s	....	t	t
July	s w	16	....	79 4	Mal., scarlet fever wh. cough.	"	36	....	13	....	g and s	g and s	....	f	g
August ..	s	16	...	77.4	Malarial, remit., inter. fevers	"	39	....	13	....	g and s	g and s	....	f	g
Sept	n e	5	....	73	Intermittent, remittent fever	"	38	....	14	....	g and s	g and s	....	t	g
Oct.........	n e	11	....	63.4	Malarial fever....................	Catarrhal, epizootic	48	....	15	....	g and s	g and s	....	t	g
Nov	n	15	1	51.7	A few cases of scarlet fever....	among horses.........	48	....	15	....	g and s	g and s	....	t	g
Dec.........	n w	10	1	43.3	" " "	....	48	....	15	....	g and s	g and s	....	t	g

Population of county .... Population of Wilmington 17,600.

REMARKS.—Drainage of streets and general sanitary work has been continued throughout the year, and the court house and city hall much improved. The poor house is not in a good sanitary condition, but it is to be improved by making more room for inmates, the sick being provided for in the hospital about to be erected. The question of the disposal of garbage is still in its infancy, and the small amount of sewerage in a wretched condition. An analysis of drinking water shows that the wells give poor, and sometimes harmful, supply of water. This is to be remedied by the erection of water works. There are fourteen frame school houses, mostly outside of the city, with good light and ventilation, and drinking water and privy accommodations. DR. J. C. WALKER, Supt. of Health.

List and causes of Deaths in New Hanover County for twelve months, ending December, 1880.

NAMES.	Jan.		Feb.		March.		April.		May.		June.		July.		August.		Sept.		October		Nov.		Dec.	
	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.
Alcoholism																								
Apoplexy	1				1																		1	
Atetectasis						1		1		3						3		1			1		3	
Abortion						1														1				
Asthma		1										1												
Brain, Disease of			2			1							2	1										
Bright's Disease														1										
Bronchitis		2		1								1												1
Burn										1														
Cancer		1			1												2			1			1	
Cholera Infantum									1		2	3	1	3		2		1	1	2		1		
Corrbosis			1																		1		1	

List and causes of Deaths in New Hanover County—Continued.

NAMES.	Jan.		Feb.		March.		April.		May.		June.		July.		August.		Sept.		October		Nov.		Dec.	
	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.
Consumption		1				3		4		1	1	2	2	1		3			1	3	1	3	1	7
Convulsions, Infantile						2	1	2		3		3		2		3		2	1	5	1	1		1
Collapse																	1							
Croup													1											
Cyanosis			1										1											
Cystitis																1								
Convulsions, Puerperal																				1				
Delirium Tremens																								
Diphtheria		3																2	2	1	1	1		
Dropsy		1		1	1			1		2		1		2		1		2		6		4		2
Dysentery									1					1							1			
Diarrhœa, Chronic														4				1						
" Infantile							1							1										
Enteritis				1					1										1					
Epilepsy											1													
Fever, Cebro Spinal		1																						
" Continued											1							1			1	1		
" Congestive										1		1			1	2		5		3	1	2		1
" Enteric Typhoid													1					1				1		
" Malarial																				3			1	
" Intermittent																			1	3				
" Remittent											1						1	2				1		
" Puerperal																				1				
" Scarlet																		1	1				1	2
" Typhus										1	1	1					1			3				
" Typho Malarial											1									3				
" Gastritis																	1							
Gastro Entrice			1											2										
Gangrene		1																						
Heart disease		1			2	1		2			2							1	1					1
Hydrocephalus														1										
Hemorrhage Uterine												1												
" Pulmonary		1							1							1								1
Homicide														1										
Infanticide								1																
Intersusception																1								
Injury																						1		

Jaundice			1													1						1		
Liver, Disease of				1										1										
Mania, Acute																								
Myetitis						1																		
Meningitis, Spinal						1		1								1								
" Cerebral																		1		1				
Malformation															1									
Marasmus			2			1				3		2	1	2			1	3	1	2		1		1
Old Age		1		1		1	1			1				1	1		1	2		1		3		1
Paralysis	2	1		1					1	2		1		1						1				
Pericarditis	1																							
Pneumonia	1	6	1	2		2		1				1	1				1			1	2	2		1
Peritonitis														1				2						1
Suicide															1									
Pyemia		1																						
Stomatitis		1																						
Trismus				1																				
Syphilis	1									1														
Tabis Menterica													1											
Tetanus										1							1						1	
Teething																	1							
Urainia										1		1												
Unknown			1		1		1					1				1		1		2				
Whooping Cough		1		2		1		3		4	1	1												
Worms												1						4						
Potts Spine Disease										1														
Cancrum Ovis										1														
Phlegmatic Dolens		1																						
Epistactischesis																						1		
Total	6	25	10	11	6	16	6	16	5	27	11	21	12	26	4	20	11	33	10	44	10	24	9	20

Total white, 100. Total colored, 283—383.

Very respectfully,
J. C. WALKER, Superintendent of Health.

APPENDIX D.—*Continued.*

TABULAR VIEW, &c., OF ONSLOW COUNTY.

Months.	Prevailing winds.	Rainy days.	Snow.	Average temperat're.	Prevailing Diseases.	Diseases of Domestic Animals.	Condition of Public Buildings. Inmates in poor house.	Cubic space each.	Prisoners in jail.	Cubic space each.	Food served to jail.	Food served poor house.	No. giving no evidence of vaccinati'n.	Conditi'n of wells.	Conditi'n of privies.
Feb.	s w	4	1		Pneumonia	Hog cholera	8				s and g	s and g			
March	ne a s	6		ave	Measles, whooping cough	Hog chol., distemper	9					g and s		g	
April	s a sw	4		ave	Measles	None	9					s and g		g	t
June	s w	4		90	Inter., billious, remitt. fever	"	9		1		g and s	g and s			
July	s a se	12		80	" " " "	"	9		1		g and s	g and s		g	g
August	se a sw	11		87	Inter., remit. fevers	"	6				g and s	g and s	2	t	b
Sept	ne a s	1		80	Billious, remit., inter, fever	"	6					g and s	None	g	g
Oct	n ne s	2			Billious fever	"	6				g and s	g and s		g	g
Dec	n ne	10	1		Typhoid fever		8				g and s	g and s	2	g	g

Population of county 10,000. Population of Jacksonville 200.

REMARKS.—In July some attention was paid to drainage, and in July and September the general sanitary condition of the town. In January and October some improvement was made in public buildings. Number of school houses not reported, but they are reported as being well ventilated, having good water and good privies.

DR. W. J. MONTFORT, Superintendent of Health.

TABULAR VIEW, &c., OF PENDER COUNTY.

Months.	Prevailing winds.	Rainy days.	Snow.	Average temperat're.	Prevailing Diseases.	Diseases of Domestic Animals.	Inmates in poor house.	Cubic space each.	Prisoners in jail.	Cubic space each.	Food served to jail.	Food served poor house.	No. giving no evidence of vaccinati'n.	Conditi'n of wells.	Conditi'n of privies.
Jan.	s u sw	3		65	Pneumonia, dysentery	Pleu. pneu., distemp.								b	bad
March	n e	15		70	Pneu., inflneza, inter. fever	Colic, grubs								n g	v b
April	n e a s	7		60	Wh cough, dys., hem. of lung.	None	none		n					n g	v b
June	s			80	Wh, cough, meas., mal. fever	None	none		n					b	g
July	s w	7		78	Measles, billious fever		none		n					b	b
Oct	e a ne	4			Inter., remit., mal., gas. fever	Staggers in horses								b	t
Nov.....s.	ne a n	20	1	40	Billious, nerveus	Epizooty in horses								bet	bet'r

Population of county 13,525. Population of Burgaw 200.

REMARKS.—There was attention to the drainage of streets in January, June and November. Some sanitary work was done in April, June and November. The public buildings are shabby temporary ones, and no effort is made to improve them. There are thirty-six school houses of logs and boards, with good ventilation, tolerable drinking water and no conveniences in the way of privies for either sex.

DR. M. E. ENNETT, Superintendent of Health.

TABULAR VIEW, &c., OF PERSON COUNTY.

Feb......	......	..	..	.....	Roseola....	...	25	500	1	1000	g and s	g and s	...	g	toler.
March.....	s se a ne	12	..	.....	Pneumonia, typhoid fever, measles, cough, influenza...	...	...	...	...	...	...	...	...	...	...

Population of county 13,000. Population of Roxboro ....
REMARKS.—No sanitary work done in Roxboro. Number of school houses not given. DR. J. T. FULLER, Supt of Health.

TABULAR VIEW, &c., OF PITT COUNTY.

Jan......	s & w	3	..	....	Pulmonary.	...	26	...	...	...	g and s	g and s	...	g	...
Feb......	s & w	2	..	54°	Pulmonary and measles.	...	30	...	.	...	g and s	'	...	"	good
March ..	s & w	7	..	59	Measles.	...	28	n't e.	5	n't e'.n	good	good	...	"	"
April....	e & s w	7	..	57	Diarrhœa.	None.	29	en'h.	5	"	"	"	...	"	"
May.....	s & w	..	..	65	Diarrhœa and dysentery.	...	29	suf't.	7	"	"	"	...	"	...
June	s & w	..	..	88	Dysentery.	None.	29	"	10	"	"	"	...	"	None
October.	s & w	6	..	54	Malarial, typhoid, measles.	...	29	"	6	...	...	...	...	...	...

Population of county, 17,276. Population of Greenville, 601.
REMARKS.—No sanitary work has been done in Greenville, and no report has been made of school houses.
DR. W. M. B. BROWN, Superintendent of Health.

TABULAR VIEW, &c., OF RANDOLPH COUNTY.

Jan......	....	..	..	....	Influenza.	...	30	...	10	...	...	...	...	tol.	...
March ..	sw & ne	13	1	....	Scarlatina.	...	30	...	9	...	...	...	...	g	mod.
July. ...	s w	3	..	83°	Billious, remittent fever.	None.	25	...	9	...	good	good	...	"	good
Sept.....	n e	1	..	70	Diptheria.	None.	27	...	2	...	...	...	...	"	fair
Oct......	s e	3	.	68	"	None.	30	...	3	...	...	...	...	"	good

Population of county, 17,551. Population of Ashborough, 182.
REMARKS.—Sanitary work and improvement in the public buildings reported for March, July, September and October. The number of school houses was not reported, but judging from the imperfect report, the privy accommodations were good.
DR. W. A. WOOLLEN, Superintendent of Health.

APPENDIX D—*Continued.*

TABULAR VIEW, &c., OF RICHMOND COUNTY.

Months.	Prevailing winds.	Rainy days.	Snow.	Average temperat're	Prevailing Diseases.	Diseases of Domestic Animals.	Condition of Public Buildings. Inmates in Poor House.	Cubic space each.	Prisoners in jail.	Cubic space each.	Food served to jail.	Food served Poor House.	No. giving no eviden'e of vaccinati'n	Conditi'n of wells.	Conditi'n of Privies.
Jan......	w & sw	3	..	65°	Pulmonary and malarial.	....	12	2345	2	504	good	good	....	g	None
Feb.	s & s w	4	..	60	" " "	....	13	2345	4	504	a and g	a and g	....	"	......
March ..	n & n w	14	..	56	Catarrhal and malarial.	Distemper, hog ch'a.	13	2545	4	501	good	good	....	"	None
May.....	s w	1	..	71	Diarrhœa and dysentery.	....	13	2345	3	405	good	good	....	"	"
June ...	s & s w	5	..	84	Inter., remit., typh., di'rhœa cholera, infl'nza, dysentery.	None.	12	2345	2	504	good	good	....	"	"
July.....	s & s e	..	..	88	Malarial fever, diarrhœa, cholera infantum.	....	12	2345	2	504	good	good	....	"	"
August..	s & s e	s	..	86	Wh. cough, chol. infantum, typo-malarial fever.	None.	13	2245	4	504	g and s	g and s	....	"	"
Sept.....	w & s w	4	..	82	Bilious, remit't and typhomal fevers, whoop. cough.	None.	12	2345	7	504	g and s	g and s	None.	"	"
Dec......	n w	6	1	56	Catarr'l, bronch's, wh. cough	Epizooty.	11	2345	3	504	g and s	g and s	....	"	"

Population of county, 18,000. Population of Rockingham, 1,000.

Remarks.—In January, February, May and July drainage of streets received attention. During the whole year the general sanitary condition of the town was looked after; and in January, June and December the public buildings received attention. There are 75 school houses in this county, the buildings frame and logs. The ventilation and drinking water are good, but no attention is paid to privies.

Dr. J. M. Covington, Superintendent of Health.

TABULAR VIEW, &c., OF ROBESON COUNTY.

Jan......	s e	s	1	55°	Pulmonary.	None.	11	......	10	18900	good	good	....	....	......
Feb......	....	..	.	....	Pulmonary and malarial.	....	10	......	10	18900	g and s	....	....	p'e.	......
March ..	var'ble	7	..	56	Malarial and catarrhal.	....	10	......	11	18900	g and s	g and s	....	g	good
April....	"	2	..	60	" " "	....	10	......	14	18900	g and s	g and s	....	....	"
May.....	s e	2	..	85	Diarr. and bowel affections.	None.	10	......	5	....	good	good	....	g	"
June....	var'ble	3	..	90	Mal. fever, bowel affections.	Hog cholera.	12	......	3	18900	good	good	....	"	"
July.....	"	s	..	84	Malarial fever.	" "	13	......	4	18900	good	good	....	"	"
August..	"	f	..	83	" "	None.	10	......	12	....	g and s	g and s	....	"	"
Sept.....	"	f	..	76	" "	"	10	......	12	....	g and s	g and s	....	"	"

Oct......	var'ble	f	..	61	Malarial fever.	None.	10	......	2	18900	g and s	g and s	....	g	good
Nov.....	"	m	2	41	Malarial and pulmonary.	....	11	......	2	18900	g and s	g and s	....	"	"

Population of county, 23,936. Population of Lumberton, 561.

REMARKS.—In January, February, March, May, June, October and November the drainage of the streets was looked after. Sanitary work was done in all the months except May, September and November, and the public buildings received attention when necessary.

DR. R. F. LEWIS, Superintendent of Health.

TABULAR VIEW, &c., OF ROWAN COUNTY.

Jan......	s w, n e	1	.	48°	Catarrhal.	....	12	......	2	....	....	....	....	g	m'te
March ..	n e, n w	6	..	50	Catarrhal, whooping cough and scarlet fever.	....	......	......	....	....	....	....	....	....	.....
April....	n e, s w	3	..	56	Catarrhal and malarial.	None.	28	......	16	....	g and s	g and s	....	soft	good
May.....	....	2	..	75	Bowel complaints in children, whooping cough.	Hog ch , chicken ch.	25	......	1	....	g and s	g and s	....	g	.. ...
June	s s w, n n w	3	..	76	Ch'ra infantum, wh. cough, mumps, typho mal. fever.	None.	18	......	4	....	g and s	g and s	....	soft	good
July.....	s w & n n e	f	..	84	Typhoid fever, bowel complaints in children.	"	18	suf.	5	suffi't.	good	good	None.	g	good
August..	. . ....	s	..	83	Typho. fever, malarial fever.	"	16	"	5	"	good	good	"	g	good
Sept.....	n e, n w	2	..	68	Malarial fever.	"	17	......	8	....	suffi't.	suffi't.	"	g	good
Oct......	nw,ssw	1	..	60	Malarial.	....	10	......	2	suffi't.	good	good	"	g	good
Nov.....	nne,sw	m	..	....	Catarrhal.	Epizooty.	15	......	11	....	....	....	....	g	p
Dec......	n e, nw	m	..	...	Catarrhal, pneumonia and bronchitis.	....	13	......	4	suffi't.	good	good	....	g	fair

Population of county, 22,000. Population of Salisbury, 2,800.

REMARKS —In January and June drainage of streets was attended to. In January attention was paid to the sanitary condition of the town. Public buildings received attention in January and April. The number of school houses not reported. They are log and frame houses and one brick house. The ventilation and drainage is good, but there has been no attention paid to the privies.

DR. J. J. SUMMERELL, Superintendent of Health.

TABULAR VIEW, &c., OF SAMPSON COUNTY.

Feb.....	w & s w	8	1	60°	Catarrhal, malarial..................	Distemper, hog chol.	12	1344	1	960	g and s	g and s	....	bad	......
April....	w & s w	5	..	....	Catarrhal, rheumatic	Distem, all over co'ty	19	......	3	....	fair	good	....	g	......
July.....	w & s w	10	..	80	Malarial, typho malarial fev.	None...........................	20	......	2	....	good	fair	....	g	none
October..	w & n w	4	..	70	Typh. fev., wh c'h, catar., mal.	Epizootic.....................	16	suf't.	4	suffi'nt	"	good	None....	t	mod.

Population of county 22,000. Population of Clinton, 650.

REMARKS —In October only was drainage of the streets, general sanitary improvements and improvement of public buildings attended to. There are 100 school houses of logs and boards, of inferior construction, and without privy accommodations.

DR. C. TATE MURPHY, Superintendent of Health.

APPENDIX D.—*Continued.*

TABULAR VIEW, &c., OF STOKES COUNTY.

							Condition of Public Buildings.								
Months.	Prevailing Winds.	Rainy Days.	Snow.	Average Temp'ture.	Prevailing Diseases.	Diseases of Domestic Animals.	Inmates in Poor House.	Cubic Space each.	Pris'n'rs in Jail.	Cubic Space each.	Food Served to Jail.	Food Served Poor House.	No. giving no evid'nce of Vaccination.	Condit'n of Wells.	Condit'n of Privies.
Jan.	s a s w	2	..	48	Diphtheria, pulmonary	....	4	1728	.....	1728	g	g	....	.....	....
Feb	"	2	1	45	Catarr., pneumo., diph., croup	Distemper	4	....	3	....	....	....	....	g	good
March	"	10	..	47½	Pneu., inter. fever, diphthe'ia	Dist., chick., hog chol	3	....	.....	....	....	....	....	g	"
April	w a s w	2	1	56	Measles, whooping cough	None	5	....	5	....	....	....	....	g	"
May	"	1	..	63	Meas., wh cough, dys., inter fe	"	5	....	5	....	....	....	....	g	"
June	"	2	..	77⅔	Measles, wh cough, dysen'ty inter., typh fever	Chicken, hog cholera	5	....	.....	....	g and s	....	....	.....	....
July	s a w	1	..	75	Meas., dys., inter., typhoid fev	" " "	5	....	.....	....	....	....	....	.....	....
August	w a n	2	..	77⅓	Diph., inter., typho. fev., dys'y	None	5	....	.....	....	....	g	....	soft	g
Sept	varia'e	2	..	68	Typhoid, inter. fever, wh cough, diphtheria	None	4	....	2	....	....	....	....	"	"
Oct	s w a w	f	..	64	Inter., typhoid, Pneumonia	Hog cholera	4	1728	6	....	s	s	....	g	"
Nov.	n a n w	4	..	48	....	....	3	....	2	....	....	....	....	g	"

Population of county 15,351. Population of Danbury 108.

Remarks.—During the year drainage in county town has been attended to in all the months but January and February. Sanitary improvement of the town has been attended in six months of the year, but in two of these imperfectly. There was noted improvement in public buildings in January. There are twelve school houses of log and frame, with good ventilation and good drinking water. The privy accommodations are adequate; sexes separate.

Dr. L. H. Hill, Superintendent of Health.

TABULAR VIEW, &c., OF UNION COUNTY.

Months.	Prevailing Winds.	Rainy Days.	Snow.	Average Temp'ture.	Prevailing Diseases.	Diseases of Domestic Animals.	Inmates in Poor House.	Cubic Space each.	Pris'n'rs in Jail.	Cubic Space each.	Food Served to Jail.	Food Served Poor House.	No. giving no evid'nce of Vaccination.	Condit'n of Wells.	Condit'n of Privies.
Jan.	sw a ne	8	2	60	Catarrhal	....	....	15520	.....	7165	g	g	....	.....	....
Feb.	"	4	..	60	Catarrhal	....	9	7165	3	15520	g	g	....	g	good
March	"	12	..	65	Catarrhal, Parotetes	Distem. amo'g horses	9	7165	4	15520	g	g	....	g	"
April	"	5	1	ave	Catarrhal	" " "	10	•15520	1	7195	g	g	....	g	"
May	"	3		74	Dysentery, Diarrhœa	None	11	15520	.....	7195	g	n	....	g	"
June	sw t ne	f	..	80	Malarial, Diarrhœa, Dysen'ty	None	10	15520	1	7195	g	g	....	g	"
July	"	f	..	92	Malarial, typho fever	None	11	15520	3	7195	g	g	none	g	"
August	"	8	..	90	" " "	None	11	15520	4	7195	g	g	none	g	"
Sept.	"	f	..	85	Typhoid fever, dysentery	None	12	15520	6	7195	g	g	none	g	"
Oct.	sw t ne	f	..	70	Catarrhal	None	10	15520	1	7195	g	g	....	g	"

Nov........	variab	19	..	45	Typhoid, catarrhal..................	Epizootic..........	10	15520	1	7195	....	....	....	g	good
Dec..	"	20	3	25	" "	Epizootic..........	10	15520	1	7195	g	g	....	g	"

Population of county 18,000. Population of Monroe 1,600.

REMARKS.—Drainage was done in January and August. Throughout the year, excepting October, November and December, efforts were made at sanitary improvement of the county town. There are ninety-seven school houses, log and frame buildings, with good ventilation and good drinking water. The privies are adequate and the sexes separated.

DR. ISAAC H. BLAIR, Superintendent of Health.

TABULAR VIEW, &c., OF WARREN COUNTY.

Jan......	sw, n & n e	11	..	52	....	Distemper and hog cholera.	8	1600	10	2668	good	good	18	g	good
Feb......	s s w, n	9	..	48	Pulmonary.	Distem'r am'g horses	10	"	9	"	....	....	....	"	"
March...	n n e	19	..	42	Pneum'a, influenza, measles.	Dis., quin'y a'g hor's	11	"	5	"	good	good	5	"	"
April....	wnw, e	3	1	44	Mal., pneum, infl'a, wh. c'gh.	Pneum'ia and lung fever amo'g horses, cholera in hogs.	10	"	7	2163	g and s	g and s	....	"	"
May.....	n n e	..	..	52	Inter. fev., diarr., dysentery.	None.	11	"	6	"	g and s	g and s	....	g&s	"
June ...	w n w & s e	..	..	80	Mild form of remittent fever.	"	11	"	5	"	good	good	....	g	"
July.....	e, w, sw	13	..	81½	Mild malarial typho.	"	11	......	5	"	g and s	g and s	None.	"	"
August..	s & s w	16	.	87	M'd malarial, typho-mal. fev.	"	11	......	4	"	g and s	g and s	"	"	"
Sept. ...	s s w	1	..	72	Mal'l, typh. fever, diphtheria.	"	12	1600	3	"	....	....	"	"	"
Oct.. ..	e s e, w	2	..	50	Malarial fever.	Epizootic.	9	"	4	2000	good	good	....	"	fair
Dec.. ..	n n e, w	17	5	....	Pulmonary and bilious.	....	4	"	8	"	good	good	....	"	

REMARKS,—Drainage in county town was attended to except in the months of January, October and December. Efforts at sanitary improvement were continuous throughout the year, and also of the public buildings. Fifty-six school houses, of log and frame buildings, with good ventilation, good drinking water, but inadequate privies.

DR. GEORGE A. FOOTE, Superintendent of Health.

APPENDIX D.—*Continued.*

TABULAR VIEW, &c., OF WAYNE COUNTY.

Month.	Prevailing winds.	Rainy days.	Snow.	Average temperatu'e	Prevailing Diseases.	Diseases of Domestic Animals.	Condition of Public Buildings. Inmates in Poor House.	Cubic space each.	Prisoners in jail.	Cubic space each.	Food served to jail.	Food served Poor House.	No. giving no evid'nce of vaccination.	Conditi'n of wells.	Conditi'n of privies.
Jan.	variab s	..	1	....	Influenza, malarial	Hog cholera	10	.....	12	.....	....	....	....	b	......
Feb.		..	..	....	Pulmonary	....	13	......	13	441	....	....	....	....	......
March	....	..	..	....	Pulmo'ry, measles, diarrhœa	....	11	32000	11	5780	v g	v g	....	g	toler
April	....	..	..	....	Meas, wh cough, diar, dysen'y	None	12	32000	4	5780	....	....	....	g	not g
May	....	..	..	85	Dys, diar, fev, meas, wh cough	None	10	32000	8	5780	v g	v g	....	g	"
June	....	..	.	85	Typho. mal. dyse'try, diarrh'a	None	......	32000	4	5780	v g	v g	....	g	g
July	....	..	..	93	Malarial	None	11	32000	3	5780	v g	v g	....	t	t
August	....	..	..	85	Malarial, typho malarial	None	10	32000	6	5780	v g	v g	....	g	t
Sept.	....	..	..	.....	Mal. fever, some diphtheria	None	11	32000	7	5780	v g	v g	....	g	t
Oct.	......	..	..	....	Malarial, diphtheria.	None	15	32000	6	5780	v g	v g	....	t	t
Nov.	....	..	1	....	Malarial, measles	None	13	......	7	5780	g	....	....	g	toler
Dec.	....	..	1	..	Malarial	....	13	......	11	... .	....	....	....	g	"

Population of county 25,178. Population of Goldsboro 3,800.

REMARKS.—For the months of January, February, March, April, May, June, July, August, September, October and December drainage, sanitary condition of public buildings was looked after.

DR. M. E. ROBINSON, Superintendent of Health.

APPENDIX E.

WHAT THE STATE OWES THE PEOPLE—PUBLIC HEALTH IS PUBLIC WEALTH.

BY HON. ERASTUS BROOKS, OF NEW YORK.

That "the world is governed too much," is a maxim that may wisely be accepted by both the people and the government; and especially is the maxim true in a republic like our own, where the people, when notified of their duty, are reasonably considerate and intelligent. The declaration of independence, the constitution of the United States, and the constitutions of the several States, all begin with some reference to the people's rights and welfare. The great object of government is the diffusion of knowledge, and the enactment of laws for the regulation of states, communities and persons, and among the first of these duties are provisions of law for the safety of the people. To secure "life, liberty, and the pursuit of happiness," is a principle of government older than the constitution, and as such it was embodied in the first record of our national existence. It is safe, therefore, to say, in the beginning of what we have to present to the American Public Health Association, that there can be no real life or happiness where the public health is not provided for by law; and that the state is only in the discharge of one of its first duties, when it seeks, under reasonable laws, to maintain the chief end of its existence.

In the Congress of the United States, and in the legislatures of the several States and Territories, it is exceptional to find members of the medical profession. Here and there, it is also true, only are found men who unite an interest in the political and physical welfare of the state. In a certain way we all seek that "good digestion which waits on appetite," looking for "health on both." But far more than in what we eat and drink, and put on and off, we digest our words and thoughts. Our laws are digested, and have been from the order of the Roman Emperor Justinian, now nearly 1,400 years since, to the present time. In food for the body, as in light and air for the abodes of men, the work to be done is to arrange, classify, dissolve and distribute, whatever in the one case is nutritious, from whatever is otherwise; and in preparing, if I am correct, whatever is put into the stomach for conversion into blood and into chyle or chyme; and in the other case, the work to be done is to arrange, classify, work over and distribute for the use of others, whatever is necessary in books and letters for the instruction of mankind.

For more than forty-five years of my life, as proprietor, editor and legislator, I have been engaged in the second class of this kind of work. To most of you belongs the more important work which may be presented in the three aspects of reducing the mortality among the people at large, of saving the people from physical pain, and of curing the sick. If to do all this is not to make "a voyage of discovery," and "a circumnavigation of charity," then no such voyage can be taken in the journey of life. I can recall no work of equal value, nor any kind of labor calculated to promote so much human happiness.

In political governments the people are bound to seek and to enjoy, if they can, their political preferences for principles and for persons. Whether in majorities or minorities, one side will govern and the other side will obey. The two sides are essential to the welfare of the state; but while this is true, there are in all states and communities, unities and necessities, still more essential for the public good, and upon which there can be no safe divisions of opinion as to the proper uses of the authority of the state. We may have diversities of opinion as to the causes of diseases, remedies for their cure—as to climates—and exposures, as to habits of living, the safety of buildings, the best methods of drainage, sewerage and ventilation in dwellings and work-shops; but science and experience will in time solve all these differences into one practice or system, while in all that belongs to duty to be performed, or to culpability for neglect of duty commanded to be done in questions relating to the public health, there can safely be no divided counsels.

I place the subject of health as among the first, if not the very first, in the science of political economy. It is a question which belongs to the wealth of the nation and to the prosperity of the people. The man or scientist who is capable of discovering or curing disease, and whom by custom we define as a physician, is, in the established meaning of words, an experimentalist in physics, and a natural philosopher. The doctor, in brief, is a person recognized in law and practice as one skilled in the art of healing the sick through the agency of proper medicines, and it is this healing of disease in its effect upon communities which covers and governs a material fact in political economy.

We know what ravages yellow fever has produced in this country and in the world, how many lives it has destroyed, how much misery it has produced and distributed, and how much wealth it has diminished. The lessening or removal of the prevalence of this great calamity has been partly the work of physicians, and a large share of it belongs to the nursing of liberal and intelligent men and women. This work, often a volunteer service, was inspired by the noblest motives, and has again and again, and especially in this section of the country, produced the grandest results.

The state politically, but not in the sense of party politics, and the people personally, in every sense I need not say, have the deepest interest in what is called state preventive medicine. Disease among a large class is often but another name for poverty, pauperism, orphanage and bankruptcy.

In Philadelphia in 1871–'72, some 4,500 people perished from small pox. The reported loss in business there at the time, and from this disease, was $16,000,000, besides a cash value in human lives of $5,000,000 more. New York City was also a great sufferer at the same time and from the same cause, while Baltimore, Boston and Providence and other cities resisted the disease and prospered greatly, owing to a timely and thorough vaccination of the inhabitants.

The state imposes certain qualifications not only upon dealers in drugs, but upon physicians, before they can practice in the great art of prescribing suitable remedies for disease. A more important state duty is the enactment of wholesome laws to prevent disease. This is done without infringing upon the personal or political rights of any citizen.

The first duty is to remove the cause of all pestilences and epidemics, foreign or domestic; and where these unfortunately prevail, the second duty is, by vigorous administrations of proper laws, to prevent their spread and put an end to their existence. When the pleuro-pneumonia came into the United States from Holland—once the great depot of this disease in Europe—and when, to an alarming extent, it was carried into England, the realm, the state and the Federal governments did not hesitate to act forcibly and promptly for its removal. Holland, profiting by experience and energy, reduced by inoculation the disease to one or two per cent., and finally stamped it out. If Massachusetts and other states have accomplished a great work in preventing the lung plague in cattle, what ought not all the states to do in preventing even a worse disease in men, women and children? To a woman of Massachusetts is due the honor of suggesting the first Board of Health in the United States. A decent care for the people by the state and a decent respect for the government by the people establishes reciprocal relations which no party can neglect. The lives, health and happiness of all classes of citizens depend upon these mutual observances of duty; and hence the existence of State Boards of Health, all created by law to present, discuss, and enforce obedience to the laws passed. The law, in all its provisions, is for the common good. It is a simple application of the science of medicine in the form of remedies or preventions to the people of the state. It teaches mankind not only the inestimable blessings of light, and air and water, of ventilation and drainage in dwellings and places of business, but the absolute need of the best use of these great gifts in nature, chemistry and discovery.

It is demonstrated in the city from whence I come, by the President of the City Board of Health, that thousands of young lives have been saved yearly for ten years and more by the enforcement of health laws passed by the State. Recent laws relating to the tenement houses will impart great comfort to their poor occupants and add largely to the number of lives saved. The death-rate of the city now numbers between 20,000 and 30,000 each year, and one-third of this number of lives could be saved if the health laws could be enforced. Eminent physicians, verbally and in their written reports, assure me that one-third or more of the prevailing sickness in town and country could be prevented by the observance of sanitary laws. Mr. Edwin Chadwick stated three years ago, to the British Scientific Association, that both the sick and death-rate had been reduced one-third by the practice of sanitary laws, and that the death-rate in the old districts had come down to sixteen or seventeen in each thousand deaths; and he declares that in new districts, with no overcrowding, and with a proper supply of water and surface cleansing, that the death-rate can be reduced to ten in the thousand, which is nearly two-thirds less than the mean death-rate among the general people.

More remarkable than even this encouraging promise, but resting upon the common sense rules of fidelity in public service—and adding, perhaps, a becoming sympathetic interest in the happiness of mankind—is the statement that in well-governed institutions for children between the ages of three and fifteen years, the death-rate can be reduced to two-thirds of the number generally prevalent, or to three in each 1,000 children, and with a corresponding immunity from all common epidemics. Even in the British reformatory prison, by the careful use of preventive medicines, the death-rate has been reduced to three in the thousand, with a general exemption from diarrhœa, dysenentery, typhus fever and eruptive diseases. The diseases belonging to the respiratory organs are also reduced by care to one-half.

The cholera epidemic which prevailed in England in 1832 frightened the people there into the necessity of securing more of the decencies of life than had before been enjoyed. The panic of a scourge, like most other panics, prompted many of the people to put on their thinking caps, and from the consequences of the cholera came, in the course of ten, twelve and fifteen years, valuable government reports and laws. These laws, if Dr. Bowditch be correct, are in advance of the laws of all other countries; and one man, Dr. Farr, has been the bright particular star in this work of sanitary reform, not only for Great Britain, but in many other parts of the world. If disease spreads by contagion, so also good example and benevolence inspires imitation and secure their reward. The great pioneers of the world in discovery and work have proved its greatest benefactors, and to the good beginnings at home and abroad we owe to day the existence of twenty-four State Boards of Health in the thirty-eight States of the Union, and all these have been established within twenty years. Lord Beaconsfield spoke the truth for his own country when he said, as Prime Minister of England, three years since, that "the health of the people is the first duty of the statesman." This sentiment is at least equally true in a country of such enormous proportions as our own, and daily increasing, not only from its own inherent growth, but as the destined home of so many millions of people in the old world.

The government and the states are not asked for what so often excites and thrills the body politic by the possession of place, patronage and power, but simply to engage in the paternal works of saving the lives and promoting the health of the people. The appeal is to the common sense and practical humanity of members of Congress and of the Legislatures of the states, some of whom, as in Mississippi, Alabama and Texas, have already performed a work of moral and social importance, not only to the people of their own states, but in the way of example to all non-acting states. The motives for the needed work are the highest of our best natures, "since the greatest good to the greatest number of the people" is all that is asked.

If, when governed by such considerations, the people refuse to act, the law here as abroad must take its course, and penalties imposed for its violation. Nor is it enough, as expressed a hundred years ago and more by Edmund Burke, that "men *mean* well. It becomes them to DO well." You are asking nothing new of states. Centuries ago the republics of Greece and Rome had their sanitary laws, and the argument then as to-day, as a part of the important work of the period, was that physical culture would secure physical health. The old Romans had their systems of ventilation drainage and sewerage, their splendid aqueducts, baths and pavements, and all of them promoted the comfort, convenience and health of the people. Sanitary law also was a part of the Mosaic law, and in practice better at times than the customs in very many of our own American towns and cities in the closing years of the nineteenth century of the Christian era.

Among the lost arts and blessings of mankind unfortunately were the lost codes of laws relating among other things to the public health. The code of Justinian and the laws of Lycurgus, with laws for justice and health, went into decay, and for a thousand years and more books and learning, and in a certain sense, deeds of practical charity, were confined to the monks. It was long a forgotten lesson among general teachings that "cleanliness was next to godliness," and therefore a very close neighbor to all kinds of practical piety. Hence, and clear up to and far into this nineteenth century, came agues, malaria, small-pox, cholera, scurvy, plagues and pestilences, and all the inherited ills of life to which, from negligence and ignorance, flesh and blood are exposed. Happily for the world public opinion is now aroused in the interest of the public health, and the subject reaches us to-day in the three-fold form of economy, thrift and morals.

If, as alleged by way of criticism, the health service is costly, it can be proved to be the best possible investment to meet the cost. We begin in the New York State Board this year with an appropriation of $15,000, and it may be more or less hereafter. The City Board of New York asks for the year 1881 the sum of $253,363, and it is money so well invested that in buildings, institutions, in saving health and lives, it will save more money to the city, in income and taxes, than any investment of the most skillful financier in Wall street. If to this result the money value of life is counted, the five or six thousand lives yearly saved will run into some millions of dollars. In Great Britain they place this kind of value upon human existence, just as we say in the United States that the cash value of every able-bodied immigrant from the Old World is $1,000 There Dr. Farr—perhaps the highest authority in the Old World—placed, in his reports as the registrar-general of the government, the money value of each man, woman and child in the United Kingdom at $795. The neglected preventable deaths in England and Wales during the school period, apart from infant mortality, makes a loss to the state of $95,000,000! The British life insurance companies and friendly societies also give the money value of work lost by sickness. For every death there were, as proved on careful investigations by the government, two persons always sick and disabled, thus making a loss for each death of 730 days in each year. This result is reached by placing the minimum of the entire population at the sum of $795 here named, and to these figures are added 50,000 lives lost annually in the school age in England and Wales, which might be saved. But such statistics are exhaustless, and I must soon leave them for more practical conclusions.

In considering the subject of State law and personal work it will be wise to recognize the principle in regard to disease—especially is this true in cases of quarantine—that it is not places, but *principles*, which secure public health. This rule applies alike to the ship, the shop and the home. Ship fever under proper treatment and practice has become what Dr. Vanderpoel has called almost a mythical disease and by simple cleanliness it is now easily mastered.

Cholera, though not mastered by being stamped out in the same way, is often under control, and its spread into towns and states, and along the coasts and rivers, can be prevented. It always comes from importation. Importation, if need be, can be forbidden, and by law and care its spread, if it should come, can be prevented. When in 1832, 1848–'49, 1854, 1865–'66, it entered the United States and Canada, it traveled as fast as travelers could be borne by steam to the far West, and left its footsteps of sorrow all along the road from New York and Quebec. So also in 1848 it entered New Orleans from Havre, and forced its way all along the Mississippi, reaching towns and cities 1,000 miles apart, and, surviving the winter, it pursued its ravages over land and water in 1849–'50. Had the United States, or Louisiana alone, possessed powers given them under existing laws, no such disaster could have occurred.

Sanitary laws properly executed, I need not say in this place, have prevented and can prevent the spread of cholera. The law, however, must be supreme, and not only supreme, but cover districts, precincts, towns, counties, states and governments, even to the interposition of international authority. There must be the *cordon sanitaire*, as along the vast frontiers of Russia, and maritime law in the hands of faithful officials, and these officials must be sanitary officers, as we have seen them upon the Red Sea and the Mediterranean, at Medina and Mecca, keeping back and pushing forward the hundreds of thousands of Mussulman pioneers, who, but for the law and its vigilant observance, would bear disease and death wherever their footprints are found.

What John Stuart Mill calls "the limits of the province of government" we must agree, whether spoken of the state or of the citizen, excludes no good work. It may and should exclude all those needless forms of non-intercourse common to the middle ages and to later periods of time, and all oppressive methods of administration, as when petty despots govern the people; but whatever is needed for the absolute good of the people in establishing and maintaining the public health must be done. If the law is a bad one, repeal it because it is a bad law, or amend it until it becomes wise and timely. In New York we have a compulsory law requiring vaccination, but it is a dead letter except in a single city, and vaccination is generally reduced to deeds of charity or to simple individual volition, even when the public welfare requires obedience to the public statute. It is the cost to the state that some people complain of, but as a question of state economy I hope I have removed this objection. The real state cost in all the United States at present is less than $5,000 for each million of inhabitants, and the saving covers the cost ten times over. The civil war destroyed 600,000 persons. Sickness wastes more than war—20,000 a year in London and 120,000 in the United Kingdom, and if recorded figures from medical men are true, 700,000 years of individual human life are yearly lost by preventable neglect among the 5,000,000 of people in the State of New York, and 70,000 years of human life are also wasted every year there by sickness, and New York is no worse off than other States of the Union. These lives fall short ten years each of what they should be. So in England, also, we read the important truth, that in the healthy districts of the kingdom persons who reach the age of twenty years pass on to the good old age of three score and three years and nearly a half; while in the general districts death comes within forty-five years. The annual money loss of this single death record, coming from ignorance, neglect, and crime, is stated at nearly $50,000,000, besides the loss from impairment of health and from poverty among those not positively dead.

When it is known that in small-pox, isolation and vaccination provide a certain cure for a loathsome disease, the existence of which is concealed where it notoriously is, the law or its officers are at fault. When it is also known that bad air produces bodily and mental disease, and that proper ventilation, heating and water supply are remedial measures, it is the duty of the law put in practice to point out and remove the evil. The law, in some of our cities at least, prescribes where houses shall be built, of brick or stone only, and if it is a wise law may not the construction and drainage of dwellings and work-shops also be regulated by law? Mr. Edwin Chadwick says that by following out a correct principle three houses may be well drained at the present cost of one, and Mr. Edward Atkinson, also good authority, declares that unsafe buildings cost more to construct than fire-proof buildings. It is proposed in England to guarantee dwellings as safe to live in on the score of health, and simply by evidences of proper construction and drainage. When sewer gas poisons the blood and produces dysentery and malaria in other forms, who shall condemn any proper law intended to prevent poison and self-inflicted murder? So in regard to adulterations of food. Take, for example, the simple article of candy, much of which is reported to be made from grape sugar, glucose and terra alba; the latter being sold at one cent a pound, and the former at four cents a ponnd, where granulated sugar costs, by the barrel, ten and a half cents—the cheaper candy may be impaired by impurities from fifty to seventy per cent. It is a public duty to resist all impurities, both in the food we eat and in the contaminated air we breathe; in all dwellings, and all work-shops, and in all that is around them; and let me say in speaking, alike for the state and citizen, that *obsta principiis* is the only safe rule of action.

This subject addresses itself to the hearts, minds and bodies and estates of every man and woman in the land. The real wealth of a nation is counted not in mines of gold, silver and coal, nor in the more useful metals of iron, lead, copper and tin; nor yet in the millions of acres of land cultivated by between five and six millions of our people; nor in the work produced by half this number of persons employed in the manufactories and workshops of the people; nor yet alone in the treasures brought up from the depths of the sea, or borne upon the two oceans which surround us; nor from or upon our grand lakes and large or limited rivers. These are vast, grand and stupendous sources of material wealth and of physical greatness. But, as far above them all as the heavens are from the earth, as a simple question of value, is the general health of the people. Here alone is true manhood, real civilization, contentment in life, peace and rest in the family, pervading happiness and substantial good will among men. Here alone the personal man is the temple of the undying soul, and only the purified abodes of men are fitting habitations for this vital principle.

We sum up, in conclusion, the duties of the Federal Government and of the State in the following order:

First.—Supervision over the health of the entire people; peaceably if it can be done, forcibly if necessary. Where the Federal Government has authority, as upon the sea, lakes, rivers, over forts and arsenals, over the army and navy, in the legislation for commerce, international and internal, especially in regard to infected vessels, over animals exported and imported, this authority belongs to Congress. It has been proved, I think, after the most laborious investigations for nearly two centuries past in this country, that the epidemics appearing among us have been traced to importations. If epidemics in this and other gulf cities seem to disprove this fact, the seeming exception is due to the bad sanitary condition of the localities named, or to the fact, as stated by Dr. Vanderpoel, to the germs of disease concealed and dormant in some cellar or room not reached by the purifying air of heaven in the place where the disease exists. The port of New York, for four months of the year, has been as much exposed as New Orleans to yellow fever, and it has been kept away from New York, not by any system of non-intercourse, but simply by the practice of correct principles of quarantine by vigilant and capable officers of the state.

Second.—State governments are clothed with power over the health of the people within the commonwealth and over all the territory where the Federal government is without jurisdiction. The colleges and schools of the state, its institutions of charity and learning, its prisons and reformatories, its codes and laws, all that belongs to roads, avenues, parks, canals, docks, piers and even to public and private dwellings, when legislation is needed for health, belongs to the parental care of the state. Epidemics are to be treated like public enemies, and often they are worse than armed foes because more insidious and beyond observation. They come in foul sewage, polluted streams and corrupted wells of water. They come also like a thief in the night and steal away those jewels of the household, the little ones, whose lives are more precious than all the wealth of the state. To prevent adulterations in food and drugs—not practiced I hope and believe to the extent reported or suspected—is another of the state duties. To clothe boards of supervisors and trustees in towns and villages, and mayors, common councils and health boards in cities, not only with ample power in regard to health, but to require them to pass and enforce ordinances, is a positive duty of the state. A state department of health is essential to secure these results, and in its actions it must be impartial, effective, vigorous, determined, and take no step backward.

Third.—While Federal and State governments are bound to do what is here suggested, a higher law of duty rests upon the women of the household and upon faithful men of business. When a woman suggested the first Board of Health in the states, the appeal only came when a typhoid fever was discovered in a seminary of learning at Pittsfield. The state cannot secure obedience to law without the sympathy and co-operation of the people. Light and air, cleanliness and order, are the great preservers of health, and the wives, mothers and daughters, as the necessary mistresses of our dwellings, can best serve the state when they secure the greatest possible health in their own homes. Dr. Farr prescribes the right remedy when he says, that "health at home is health everywhere," and when he adds as his conclusion from experience that "the whole future sanitary movement rests for permanent and executive support on the women of the country." If it be true, as stated by the President of the State Board of Health for Connecticut, that "the predisposing causes of insanity in the United States can be traced to malign influence on childhood," no wonder that we have from Dr. Wilbur, of New York, the startling record that there are 50,000 lunatics in the country, nor that we are behind England, Germany and the age in which we live in our treatment of this class of unfortunate people.

Finally, a word as to quarantine. Commerce cannot be forbidden, but it may be regulated when hurtful to health. At best, however, state law is only a relative guarantee of the public safety. Quarantine and commerce are naturally enemies, and the state must regulate the relation between the two—the state always insisting that, as far as possible, the public health within its borders shall be permanent. Every nation and every state has the right to use intelligent ways and means to preserve health over all its borders, and the Federal Government also has rights which must be respected and laws which must be obeyed. There are natural, legal, wise and conservative lines between nations, states, municipalities and towns. Where the death-rate in England is 19 9 in the 1,000, in Austria 31.3, and close on to the latter number in all parts of Italy, official action is demanded in the name of public safety.

Drawing, then, only the proper lines between nations, states and local authorities as a question of commerce, all in established authority may, under the administration of wise laws, be able to say to Congress for all rivers passing between different states, and for all lakes bordering upon these states, and for the great highways on the ocean touching our American land—

> Bid harbors open, public ways extend ;
> Bid temples worthy of the gods ascend ;
> Bid the broad arch the roaring flood contain,
> The mole extended break the roaring main ;
> Back to her bounds the roaring sea command,
> And roll obedient rivers through the land.

APPENDIX F.

LIMITATION AND PREVENTION OF DIPHTHERIA.

BY R. L. PAYNE, M. D.

In consideration of the fact that diphtheria has been prevalent in many sections of North Carolina at various times since the year 1861, bringing suffering, death and woe to many a happy household; and because it is again committing its ravages in some parts of the state, the State Board of Health deem it their duty to publish the following circular, hoping thereby to admonish every citizen not to neglect any precautions which may be calculated in the least degree to prevent the spread of the disease, and hoping to impress every one with the possibility of limitation and prevention.

While there are some things still unknown, and unsettled as to diphtheria, its law of contagion and its spontaneous origin, yet a sufficient number of facts respecting its prevention have been deduced from the very large experience which has been accumulating for the last eighteen or twenty years in this country, to warrant the publication of the best known of them.

CONTAGION. Is diphtheria contagious? This is still a mooted question, and, while some good observers deny it, the weight of testimony is very largely in favor of it. From a large experience with, and close observation of, the disease in different epidemics, we cannot for a moment doubt its contagiousness, and we hope that in our present state of knowledge *no theories, however plausible,* will be suffered to beguile the householders of our state into the belief of its non-contagiousness. If we be still to some extent in the dark, as a matter of prudence let us hold fast to the safer side until the dawn of greater light.

It is true that the contagiousness of diphtheria differs essentially from the more familiar examples of it in measles, small-pox, whooping-cough, scarlet fever, etc. In these diseases the time which elapses from contact with the person affected and the seizure of the person exposed, is fixed and well known, so that we can speak definitely of the laws which govern them; but our knowledge of diphtheria is not yet so definite. However, it is confidently believed that it will be shown in the future to have its fixed period of incubation too.*

The first manifestations of the disease are nearly always either in the throat, nose or mouth, and this would seem to indicate that the causative elements invade the body through these most exposed channels, leading to the inevitable conclusion that the breath of diphtheria patients is dangerous, and that the contagious elements may be conveyed in the air. It is a zymotic, or constitutional disease,—that is, the blood is always poisoned in those affectend with it. An eminent writer, speaking of it says:

"Zymotic in its nature it tends to fasten upon whomsoever is debilitated by previous disease, or by a constitution naturally feeble, and artificially effeminized, or whose vitality is lowered by the depressing influences of luxury, indolence and inactivity; and the habitual defiance of physical and hygienic laws. * * * * * Finally, all we can affirm is that, as a general rule, anti-hygienic conditions of any kind favor the invasion of diphtheria, as well as of other similar epidemic diseases."

Unlike most other specific diseases, one attack does not exempt the person from subsequent attacks, but appears rather to render such a one more liable to be smitten again.

*The writer was attacked with diphtheria just a week after a piece of membrane from the throat of a patient came in contact with the mucous membrane of his own mouth.

Consequently the cautions which follow are as applicable to these persons as to those who have never had the disease.

LIMITATION.

Can any means be resorted to which will in any measure prevent or even limit the spread of this terrible scourge? We believe this question may be safely answered in the affirmative, since already most encouraging results have followed such attempts in various localities. Therefore, we believe it to be our bounden duty as philanthropists to *redouble our efforts in this direction!*

It has been shown (as far as our enquiries have extended,) that in the Southern States, the season of the greatest prevalence and malignancy of diphtheria, is during the time of the greatest soil-soakage, that is, during and after the usual autumn rains. The connection between the appearance and spread of this disease, and the soil saturated with rain, and holding in solution all of the foul washings from the surface of the earth, as fecal matter, decomposing vegetable matter, garbage, &c., has not yet certainly been established, but enough is known to lead to the belief that there is some connection. Of course, the same soil-soakage, etc., existed in North Carolina before diphtheria became epidemic, and did not beget the disease. Once introduced, however, and having this pabulum to feed upon, it spread from house to house, and we have no doubt that such a condition of foul decomposition tends materially to promote its spread, yet we freely grant that we have seen many a severe case of diphtheria during the prevalence of dry weather.

Our *confrere*, Thomas F. Wood, Secretary of the State Board of Health, has prepared a very excellent diagram of the death rate of diphtheria in Wilmington, N. C., from which it appears that the greatest death rate in that city happened about and soon after the seasons of the greatest rain-fall, and most extreme heat.*

DRAINAGE. What we say of drainage is applicable to all infectious diseases. Perfect drainage is the precedent condition of prevention in all of them. A badly drained city, town or locality, runs risks which are proportionate to the inefficiency of its plan of drainage. The soil of any situation which is soaked with stagnant water, is sure to be soaked with foul water, and all water which is rife with animal and vegetable decomposition, is a most prolific hot-bed of infectious diseases.

One of the paramount conditions then, of pure water, is that it shall have free circulation, shall flow freely, and one of the essential conditions of harmless soil, is that it shall have a free circulation of ground air. Thorough drainage, therefore, becomes a most potent factor in limiting the spread of diphtheria, and should never be neglected.

VENTILATION in and under dwellings should be secured and made effectual, because nothing contributes more to good health than pure air! Pure water, pure air, and a plenty of sunlight are of the utmost importance in a hygienic point of view. As much sunshine as possible should be let into the damp shady corners, and such places as cannot be remedied by drainage should be frequently covered with unslacked lime, charcoal or solutions of green vitriol.

WELL OR SPRING WATER must not be used if there be any reason to suppose that the water is impure, unless there be no other source of water supply, and even then that for drinking purposes should be boiled before using. *All wells or springs near a privy should be suspected, because although we may not be able to detect anything wrong either by taste or smell, such water is very probably most impure.* Ditches and drains should be so constructed that all the surface washings shall

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* See Dr. Wood's paper and diagram in the N. C. Medical Journal for March, 1878.

be carried as far as possible away from wells and springs, and the habit common in some parts of the State of allowing children to urinate, and sometimes, even empty the bowels behind the well house, or near the well or spring, should be immediately abandoned, since these excrementitious matters are washed into the well or spring by the rains, and thus become fruitful sources of disease.

YOUR PRIVY should be carefully attended to. Destructive deodorants, such as unslaked lime, copperas water, ($1\frac{1}{2}$ lbs. to the gallon of water,) or if nothing better is at hand, common wood ashes should be applied every day, or at least every other day. Dry earth may be used for the same purpose, but is not so effectual, because it cannot penetrate deep into the mass.*

DIPHTHERIA IS A DISEASE DANGEROUS TO THE PUBLIC HEALTH.

Therefore the County Superintendent of Health should be notified as soon as a case occurs in the county.

AVOID THE CONTAGION.

In the first place, all persons should endeavor to keep out of the way as much as possible; and secondly, all persons sick with the disease should be promptly separated from the rest of the family and the public, and should have no one about them *except such as are absolutely necessary.* Carpets, curtains, and all other textile fabrics not necessary, should be removed at once. Bare floors are to be preferred, and widows without curtains let in needed sunlight. Fresh air should be freely admitted into the room of the sick, care being taken not to expose the patient to draughts, and a fire should be made morning and night, and in damp weather

*See Circular on Drainage, Ventilation, Water Supply and Disinfectants.

should be kept burning all the time, because a fire dries up the dampness, and promotes the circulation of pure air.

ALL DISCHARGES FROM THE PATIENT

Should be carefully destroyed. Those from the nose, throat and mouth may be received upon soft rags, and these should not be suffered to accumulate, but should be burned soon after using. The evacuations from the bowels and bladder should be received in vessels and immediately disinfected with sulphate of zinc, chloride of zinc, copperas, or some other destructive disinfectant, and then be buried as far as possible from the well. *Perfect cleanliness of patient, nurses, floors, furniture, clothing, utensils, etc., etc., should be scrupulously attended to!* The bed-clothing, and the clothing of the patient, must be often changed, and those taken off should be immediately put to soak in water having in solution of chloride of zinc or chloride of lime, and allowed to remain in soak several hours. Spoons, cups, and all other utensils used by the patient, should be cleansed in the room, and be confined entirely to the use of the sick, and the dish-water after being disinfected, should be buried with the excrement.

The condition of the yard, garden, stable-lot, and all other surrounding lots should be frequently inspected, and all garbage, and filth of every description carefully removed, or destroyed by being well covered with unslacked lime or dry earth.

The kitchen, smoke-house, poultry-house, pig-sty and stables, should be kept as free from filth as possible, and all such out-houses should never be built near the well or spring. Cellars should be kept clean and dry, and have plenty of sunlight. The slop tub should not be suffered to become a nuisance.

VISITORS TO THE ROOM OF THE SICK

Should be limited to the physician and the nurses. All others will be in the way, and might be the means of spreading the disease. CHILDREN SHOULD NOT BE ALLOWED TO GO NEAR ONE SICK WITH DIPHTHERIA; and during the prevalence of the disease, at least, the foolish custom of kissing should be prohibited. Even with these restrictions the well children of the household where there is diphtheria should not go to school, or visit other children.

CONVALESCENT PATIENTS

Should be considered dangerous as regards the possibility of conveying the disease, and should not attend church, school or any public assembly, and should not visit other children until some competent physician declares it safe for them to do so.

FUNERALS.

Public funerals of those dying with diphtheria should be discountenanced. *In truth, such funerals should be made as private as possible.* Only those who are necessary to bury the dead decently should follow the body to the grave. Kissing the dead body, however much the custom, should be abandoned. The pall-bearers, if any are chosen, should be from among grown persons, for as in this disease one attack affords no immunity from a second, of course it would be impossible to select persons not liable; but the nearest approach to this will be in selecting grown men as being least liable.

The body should be buried without unnecessary delay, and it is advisable that it should be taken from the room in which the death occurred to the cemetery, thus obviating the chances of infecting any other room.

After a death or recovery from diphtheria, the room in which the patient has been confined, as well as all clothing, towels, etc., used, should be thoroughly cleansed and disinfected.

All articles of apparel, bed-clothing, towels, etc., should be spread out, so that the greatest amount of surface may be exposed, and every opening to the room securely closed, so that the fumes of the disinfectant may not escape. We believe one of the cheapest and best disinfectants to be used in rooms infected with diphtheria, is sulphurous acid gas, and this may be readily generated by putting live coals of fire into a common iron pot already partly filled with ashes, and then sprinkle sulphur in powder, or in small particles upon the coals. The room should be subjected to this fumigation for several hours, and afterwards thoroughly aired by opening all the doors and windows. "A pound and a half of sulphur is sufficient for 1,000 cubic feet of space." If chlorine be preferred, take four ounces of the peroxide of manganese, place it in an earthen dish or crock, and add to it one pound of muriatic acid. Used in this way, chlorine will be evolved, and the process may be repeated as often as necessary. Care must be taken not to inhale either of these gases.

For further directions upon disinfectants, the reader is referred to Circular on Ventilation, Drainage, Drinking Water, and Disinfectants.* *We believe that if the foregoing precautions are strictly observed, the spread of diphtheria will be greatly limited*, if not entirely prevented.

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*The writer is greatly indebted to Dr. Thomas F. Wood for his MS. notes on diphtheria, which have been freely used in the preparation of this paper.

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