An inaugural dissertation, shewing in what manner pestilential vapours acquire their acid quality, and how this is neutralized and destroyed by alkalies : submitted to the public examination of the faculty of physic, under the authority of the trustees of Columbia College, in the state of New-York, William Samuel Johnson, LL.D. president ; for the degree of Doctor of Physic, on the 2d day of May, 1798 / by Adolph C. Lent, citizen of the state of New-York.

Contributors

Lent, Adolph C.
Swords, James, 1765-1846
Swords, Thomas, 1764-1843
Columbia College (New York, N.Y.)
National Library of Medicine (U.S.)

Publication/Creation

New-York : Printed by T. & J. Swords, printers to the faculty of physic of Columbia College, no. 99 Pearl-Street, 1798.

Persistent URL

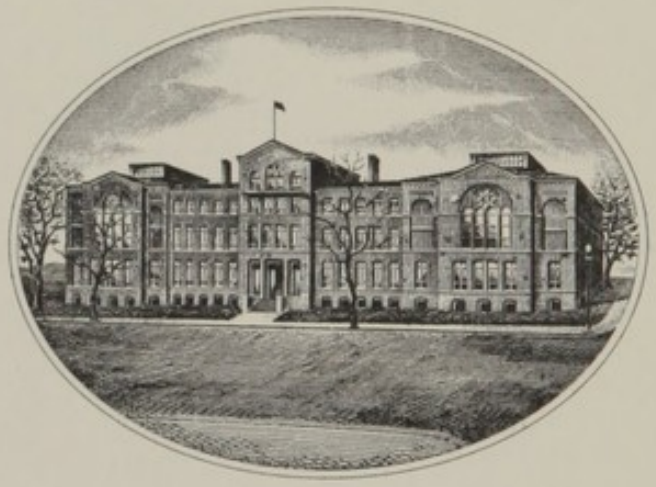
https://wellcomecollection.org/works/usamdpnr

License and attribution

Wellcome Collection
183 Euston Road
London NW1 2BE UK
T +44 (0)20 7611 8722
E library@wellcomecollection.org
https://wellcomecollection.org

NATIONAL LIBRARY OF MEDICINE

Washington



Founded 1836

U. S. Department of Health, Education, and Welfare

Public Health Service

AN

INAUGURAL DISSERTATION,

SHEWING IN WHAT MANNER

PESTILENTIAL VAPOURS

Acquire their *acid* Quality, and how this is neutralized and deſtroyed by

ALKALIES.

SUBMITTED TO THE PUBLIC EXAMINATION OF THE FACULTY OF PHYSIC, UNDER THE AUTHORITY OF THE TRUSTEES OF COLUMBIA COLLEGE, IN THE STATE OF NEW-YORK,

WILLIAM SAMUEL JOHNSON, LL. D. President.

FOR THE DEGREE OF

DOCTOR OF PHYSIC,

On the 2d Day of May, 1798.

By ADOLPH C. LENT,
Citizen of the State of New-York.

CNOMES! to impede the DEMON's deadly courſe,
YOUR BANDS CELESTIAL marſhall'd all their force:
From watery caves where ſhelly nations ſleep,
From ſinuous bays, from Ocean's briny deep,
YOUR hands collecting ſpread thro' every clime,
A fair proportion of attempering LIME;
Thro' all the ſpace terreſtrial Nature owns,
Of Climates, Colures, Longitudes and Zones,
YOUR ſearch the powerful ALKALIS has found,
And caſt, the Earth's circumference around;
The friendly powers of METAL, OIL and CLAY,
With duteous zeal your juſt commands obey;
With wiſe diſpatch their various ſtations gain,
And guard the Mine, the Mountain, and the Plain.

MITCHILL.

NEW-YORK:
Printed by T. & J. SWORDS, Printers to the Faculty of Phyſic of Columbia College, No. 99 Pearl-ſtreet.
—1798.—

INTRODUCTION.

General Ideas of the Diſorganization of Bodies after Death.

ALL animal and vegetable bodies, deprived of the principle of life, undergo certain changes, by which their texture becomes deſtroyed, and their compoſition altered; having loſt the chemical affinity ſubſiſting between their elementary principles in their living ſtate. The proceſs by which this decompoſition is effected, which renders more ſimple the compounds formed by vegetation and animalization, and cauſes them to enter into new combinations of different kinds, is named putrefaction, and is determined by the ſame cauſes, agents, and circumſtances, in both, viz. oxygenous air, caloric, and water. Upon a proper application of theſe agents does the more rapid or ſlow diſſolution of theſe bodies depend. Animal ſubſtances, compoſed of hydrogene, carbone, oxygene, and ſepton (azote), and not unfrequently ſtill more complex by the addition of ſulphur, phoſphorus, iron, lime, and ſoda, when deprived of that conſtitution which imparts to them life, and expoſed to the influence of theſe agents, are ſoon altered by more ſimple attractions between their elements, which moſt generally have a tendency to unite in binary

or ternary combinations. This new aſſociation between their principles gives riſe to new bodies, ſuch as ſeptous (azotic) air, oxyd of ſepton (azote), ſeptous acid, ſeptic gas, ſeptic acid, ſeptic acid gas, carbonic acid gas, hydrogenous gas, oxygenous gas, carbonated, ſulphurated, and phoſphorated hydrogenous gas, ſoda, water, and perhaps ammonia, which gradually eſcape into the atmoſphere, proportionally diminiſhing the putrifying maſs. Upon the union of theſe elements all the changes reſulting from the putrefaction of animal bodies depend. In the union of ſepton (azote) and oxygene, *according as the acidifying principle unites with ſepton in a greater or leſs quantity*, we perceive the formation of ſeptous gas, and the oxyd of ſepton, ſeptous and ſeptic acid, and ſeptic acid gas; to the production of which it is well known how much animal ſubſtances contribute; as in nitre-beds, graves, ditches, puddles, &c. and in all thoſe places where putrefaction takes place to any large amount. The combination of carbon and oxygene with caloric, explains the generation of carbonic acid gas. The carbon and hydrogene may unite in the form of fat, or that ſubſtance ſo often deſcribed as reſembling ſpermacæti; and if ammonia is formed, it will proceed from the union of ſepton with hydrogene. It is poſſible, alſo, in bodies containing ſulphur and phoſphorus, theſe acidifiable baſes may unite with oxygene, and form their reſpective acids. Where lime (calcareous earth), ſoda, or iron, is extricated by putrefaction, theſe baſes may attach the carbonic, ſeptic, ſulphuric, and phoſphoric acids, and form

carbonates, ſeptites, ſulphats, and phoſphates of lime, ſoda, and iron. Theſe are the products, liable, however, to variation, which are evolved on the putrefaction of animal ſubſtances. It may happen that all, or a greater part of the ſepton, may combine with caloric, and fly off in this ſtate in the form of ſeptous gas: on the contrary, all the ſepton may unite with oxygene, and be converted into ſeptic acid. The ſame variations may take place in the other combinations, according as the elementary principles get within the ſpheres of each other's attraction, and according to the varying proportions of the agents above enumerated.

The products which obtain, on the decompoſition of vegetables, are nearly the ſame with thoſe of animals; except that the compounds, into which ſepton, ſulphur, and phoſphorus enter, are not ſo often formed; nor are the ſeptic compounds produced in ſo great plenty, owing to a leſs quantity of ſepton in the latter than in the former ſubſtances;—the greater part of vegetables containing little or none, though others are furniſhed plentifully with it. Vegetable ſubſtances, though liable to undergo diſorganization, are not ſo much ſo as animal; their order of compoſition being leſs complex: neither do they afford ſo much ſeptous gas when acted upon by the ſeptic acid, nor contribute in ſo eminent a degree to the formation of this acid. Theſe different appearances between the two ſubſtances, and the more rapid decay of animal bodies, ſeem to depend on the preſence of one elementary principle only, namely, ſepton, being in a greater

abundance in animal than in vegetable ſubſtances. It appears probable, therefore, that by the addition of this principle to vegetable matter, it may be made to poſſeſs ſimilar qualities with that of animal; and by depriving the latter of its ſepton, it will become, in ſome meaſure, vegetable. This may be termed the capital difference between the two ſubſtances: but other phenomena, whoſe influence on the animal compoſition is, no doubt, inferior, ought likewiſe to be noticed; ſuch as the phoſphoric acid, and its combinations with lime, ammonia, and ſoda; the quality of the reſidue of animal matter, after diſſolution, being principally owing to theſe combinations.*

* Vide Fourcroi's Philoſ. of Chemiſtry, p. 162, 163.

CHAPTER I.

Relations of the Products of Animal and Vegetable Decompoſition to other Bodies.

ANIMAL and vegetable matter having been ſhewn, on diſſolution, to give riſe to new compounds, ſuch as the ſeptic oxyds and acids, &c and as all living ſyſtems, whether of plants or animals, muſt loſe the principle by which their life is continued, and become diſorganized, the quantities of thoſe gaſeous fluids which are naturally formed and diffuſed through the air in ſuch proceſſes, muſt be immenſe, and exceed ordinary eſtimation. From the perpetual accumulation of theſe gaſeous bodies, it would ſeem the reſpirability of the atmoſphere muſt, within a ſhort period, become deſtroyed, and, from the noxious and even poiſonous qualities of certain of theſe gaſes, ſuch as the ſeptic compounds, acquire a deleterious and deſtructive operation on the conſtitution of man, and other animals who live and move in it. This, from appearances, would really happen, were it not that theſe gaſeous ſubſtances did again enter into union with certain other bodies, on coming within the ſpheres of their attractions, by which they are taken out of circulation, and become fixed or decompounded.

1. In this manner the oxyd and acid of ſepton, on meeting with certain bodies, are taken out of circulation, and become fixed or neutralized, and thus reſtrained from exerciſing their deleterious

qualities, which, if left to pervade the atmoſphere, would, on meeting the bodies of men, carry on their deſtructive and corroding operation, and produce diſeaſes of different grades and malignancy, in proportion as the attendant circumſtances, and the conſtitution of each, were more or leſs favourable to their operation.—The principal of thoſe bodies which have the power to coerce and reſtrain this acid, is pot-aſh, or the vegetable alkali, alſo called ſalt of wormwood, and ſalt of tartar, with which the acid unites, and forms the ſeptite of pot-aſh, commonly known by the name of ſalt-petre, or nitre, from which this acid has derived the name hitherto moſt commonly affixed to it. This ſaline ſubſtance, afforded by the combuſtion of plants, has the ſtrongeſt attraction of all bodies preſent, where putrefaction takes place, for the ſeptic acid,* and will, conſequently, diſengage the acid from all other bodies with which it is united, and attract it itſelf.—There are certain ſoils and tracts of country, as in Spain, Perſia, and the Eaſt-Indies, where pot-aſh is native, and by abſorbing from putrid and all other bodies with which they meet, all the acid they contain, they change to ſeptite of pot-aſh (nitre). Where this ſubſtance is not naturally preſent, it is frequently accumulated from adventitious circumſtances; near the habitations of men it is generally produced by the agency of fire; and large quantities of it, diſſolved in water, are continually thrown away with ſuch ſolutions as have

* Vide Bergman's Tab. of Elec. Attrac.

been employed to aid common water in cleanſing, and anſwering the purpoſes of waſhing.* In ſuch inſtances, where there is no pot-aſh preſent, or there is more of the acid than it is capable to neutralize, it may be arreſted by the muriate of ſoda (common or culinary ſalt), which is conſumed in large quantities by men and brute animals. The alkaline baſis of the ſalt having a ſtronger attraction for the ſeptic than muriatic acid, it will diſſolve its connection with the latter, and form a union with the former, in the form of ſeptite of ſoda (cubic or quadrangular nitre). This acid likewiſe unites readily with calcareous earth (lime), converting it into a ſeptite of lime (calcareous nitre). From the greater abundance in which lime is found in and about human dwellings, old walls, ſinks, drains, &c. than either of the above alkalies, it might be preſumed, that this acid, in conjunction with calcareous earth, would very commonly obtain. This is found to happen. The nitrous quality of old walls, plaiſtered with lime, which takes place even to ſuch an extent, as to have become worthy the attention of perſons engaged in the manufacturing of nitre, is ſufficient evidence of the ſtrong affinity which ſubſiſts between it and the acid; at the ſame time proving this acid to be preſent within and around human dwellings, in conſiderable quantity. Clay likewiſe has an affinity

* See a calculation, made by Profeſſor MITCHILL, of the immenſe quantity of this alkali diſſolved in water, which is, from time to time, thrown out in large and populous cities, in New-York Mag. for January, 1797, p. 9.

for this acid; and in ſuch walls where lime is one of the ingredients, and becomes ſaturated with the ſeptic acid, the clay will unite with it, and be converted into an argillaceous ſeptite (aluminous nitre). Its affinity, however, is in ſo weak a degree, that where either of the alkalies, or lime, is preſent, its union with the acid will be prevented, or diſſolved, if made. This acid alſo unites with the volatile alkali, for which, next to the fixed alkalies and lime, it has the greateſt attraction; but from the rare occurrence of this alkali in the earth, it will rarely happen that a ſeptite of ammonia is formed. Fat, or oily ſubſtances, will likewiſe unite with this acid, and that with ſuch rapidity as to burſt into flame with many kinds of oils. "The action of the nitric (ſeptic) acid on moſt inflammable matters, conſiſts in nothing more than a continual decompoſition of this acid."—"The nitric (ſeptic) acid, when mixed with oils, renders them thick and black, converts them into charcoal, or inflames them, according as the acid is more or leſs concentrated, or in greater or leſs quantity."* From the experiments of Margraff and other chemiſts, this acid was alſo found in rain and ſnow waters; and from the diſpoſition of water to enter into union with it, may it be learned how rain-water in ſhowers acquires the unwholeſome qualities which, in certain inſtances, it has been obſerved to exert on the conſtitution.

Hence, then, it appears, that the alkalies, calca-

* Fourcroi, &c. Chaptal's Chemiſtry, p. 133, &c.

reous earths, clay, oils, and water, on meeting the ſeptic acid, act in a beneficial manner, by repreſſing and keeping down this fluid, which, by riſing in the atmoſphere, and pervading human dwellings, &c. might occaſion intermittent, or other fevers of a more malignant or peſtilential nature.

2. Carbonic acid (fixed air), which is ſo plentifully formed during the putrefactive proceſs from animal and vegetable bodies, by reaſon of its greater ſpecific gravity, never riſes to any great height in the air, but deſcends to the ſurface of the earth, where it may either be abſorbed by lime, or may contribute to the nouriſhment of plants, which poſſeſs the power of decompounding and abſorbing it, when in a ſmall quantity.*

3 and 4. The hydrogene, or inflammable gas, that is ſometimes extricated during putrefaction, eſcapes, and mingles in the air with other gaſes, with ſome of which, more eſpecially the oxygenous it may unite, and form water; while the oxygene gas that is ſet looſe in certain inſtances, may aſcend and repleniſh, in part, the perpetual waſte which this fluid, from combuſtion, reſpiration, &c. muſt neceſſarily ſuffer, from time to time, in the atmoſphere.

5. The other gaſeous compounds, to which the diſagreeable ſmell and phoſphoreſcent appearance attending vegetable and animal putrefaction are principally owing, may combine with certain bodies they meet with, or aſcend in the atmoſphere, from whence they may again be precipitated to the earth.

* Chapt. Chem. vol. iii. p. 32.

CHAPTER II.

Facts tending to ſhew the Connection between the Effluvia of putrefying Bodies, and malignant and peſtilential Diſeaſes.

FROM marſh exhalations and human effluvia, has it been believed, from the earlieſt ages of phyſic to the preſent time, that malignant and peſtilential diſeaſes derived their origin. Daily experience ſtill confirms that it is in the neighbourhood of marſhes, and all ſuch places where vegetable and animal putrefaction takes place to any extent, that peſtilential and other diſeaſes of various grades and violence prevail. Epidemics, attended with carbuncles and buboes, which are denominated, in conjunction with the ordinary ſymptoms of what is called *jail* and *hoſpital* fever, the characteriſtics of the plague, down to the mildeſt intermittent, have appeared, and raged with extreme violence, occaſioned by the exhalations from putrefying animal and vegetable ſubſtances.* .

The numerous facts and obſervations of the moſt judicious writers ſhew, that there are few climates where inſtances have not occurred of malignant epidemic and endemic diſeaſes, occaſioned by an atmoſphere ſurcharged and poiſoned with the effluvia exhaled from certain putrid vegetable and animal ſubſtances. Bengal, on both ſides the river Ganges, and Egypt, annually overflowed by the

* Pringle on the Army, p. 321 and 322.

Nile, experience an unhealthy and peſtilential atmoſphere, immediately after the exhalations from the putrefying collections of vegetable and animal matter begin to ariſe in the air, and bring on diſeaſes of various grades of malignancy, down to what is called the plague. The ſame occurs in every climate in a greater or leſs extent. In ponds, ditches, ſwamps, &c. where, after the evaporation of the water, the collections of vegetable and animal matter being left bare, and expoſed to the influence of the ſun, begin to putrefy, and emit certain gaſeous exhalations, which transfuſe themſelves into the atmoſphere, and produce diſeaſes of an intermittent or more malignant type, proportionate to the concentrated ſtate of the contagion, and other concomitant circumſtances. Lind, whoſe teſtimony, from his experience, muſt equal moſt authors, relates abundance of inſtances where what is called *yellow fever*, and other malignant diſeaſes, were cauſed by gaſeous fluids, exhaled from low and marſhy places, expoſed to the influence of a powerful ſun. He obſerves, that "in all ſpots, in the Eaſt-Indies, ſituated near large ſwamps, or the muddy banks of rivers, or the foul ſhores of the ſea, the vapours exhaling from putrid ſtagnated water, from the corrupted vegetable, and other impurities, produce mortal diſeaſes."* The ſame author more particularly mentions, that the *yellow fever* often raged at Greenwich Hoſpital, in Jamaica, which, he obſerves, was built near a marſh, and could not

* Lind on Hot Climates, p. 85.

proceed from any ſource of infection in the hoſpital. He every where attributes the *yellow fever* to the vapours ariſing from putrefying vegetable and animal ſubſtances.

Dr. Clark, in his Obſervations on the Diſeaſes of long Voyages to hot Countries,* mentions a *contagious malignant* fever, which prevailed at Prince's Iſland, in 1771, produced from the exhalations of putrefying vegetable ſubſtances.

The plague which cauſed ſo great a terror and mortality in London, in 1625 and 1636, according to the account given by Mr. Woodal, ſurgeon to St. Bartholomew's Hoſpital, and ſurgeon-general to the Eaſt-India Company, who was preſent thoſe two years during its prevalence, was evidently generated in that city, from the gaſeous exhalations of putrid collections of animal and vegetable matter. He ſays, "the terreſtrial cauſes (after mentioning it as a puniſhment inflicted on mankind for their ſins,) are, by common conſent of moſt writers, as followeth; venomous and ſtinking vapours, ariſing from ſtanding ponds, or pooles, ditches, lakes, dunghills, ſinks, channels, vaults, or the like; as alſo unclean ſlaughter-houſes of beaſts, dead carcaſes of men, as in time of war, and of ſtinking fiſh, fowl, or any thing that hath contained life and is putrid: as alſo, more particularly in great cities, as in London, the unclean keeping of houſes, lanes, alleys, and ſtreets: from thoſe recited, and the like infectious venomous vapours, by warmth of the

* Vol. i. p. 123 and 124.

ſun exhaled, are apt and able to infect the living bodies of men, and thereby to produce the plague, as experience too much ſheweth."* From the deſcription given by Mead† of Grand-Cairo, the ſuppoſed harbinger of a ſpecies of the worſt type of diſeaſe, the plague, it will appear to be produced by ſimilar cauſes with the above caſe, viz. by certain gaſes formed on the putrefaction of vegetable and animal ſubſtances, and ſuffered to ariſe into and poiſon the circumambient atmoſphere with their noxious and ſtimulating qualities. He ſays, "it is ſituated in a ſandy plain, at a foot of a mountain, which, by keeping off the winds that would refreſh the air, makes the heat very ſtifling. Through the midſt of it paſſes a canal, which is filled with water during the overflowing of the Nile, and, after the river is decreaſed, it gradually dries up. Into this canal the people throw all kinds of filth, carrion, &c. ſo that the ſtench ariſing from it, and the mud together, is inſufferable. In this ſituation of things, the plague every year conſtantly preys upon the inhabitants, and is only ſtopt when the Nile, by overflowing, waſhes away the load of filth."

Pringle, Jackſon, Hume, and a number of other authors, might be added in further proof, that the effluvia from animal and vegetable putrefaction may give riſe to, and are the common cauſes of malignant and peſtilential diſeaſes. Inſtances, abundantly numerous, occur in our own territory, to confirm the noxious and peſtilential influence of

* Monro on the Army, vol. i. note to p. 223.

† On the Plague, p. 29 and 30.

the products juſt named, on their application to the conſtitution, notwithſtanding the (ſo named) *facts*, which were promiſed *ſpeedily to appear* almoſt a year ſince, in contradiction of this opinion. It is related by Dr. Reynolds,* that from the putrefaction of a horſe, which lay on the borders of a marſhy piece of ground, a young woman who lived near, and was obliged frequently to paſs and repaſs the putrid carcaſe, was affected with violent pains in the head, and ſickneſs at her ſtomach. On the ſecond day of attack was bled, but her fever increaſed, and ſhe became delirious. A number of bliſters, ſurrounded by inflammation, appeared upon her feet and hands, fingers and toes; and ſhe died the fourth day.

A caſe, a few years ſince, occurred in this city, where a ſevere attack of fever, of the remittent type, attended with petechiæ, made its appearance in two perſons of the ſame family. On examination into the cauſe of theſe complaints, it was diſcovered, by the attending phyſician, to have originated from the blood and other offal of cattle, ſlaughtered in the yard belonging to the houſe, which was ſuffered to collect and putrefy, to the exhalations of which the two perſons attacked had been, from time to time, expoſed. An inſtance of a ſimilar nature, which occurred to a practitioner of a neighbouring town, is related by Mr. Bayley, in his treatiſe on the epidemic of New-York in 1795.† "Some time in the month of September I was called to viſit a young man about eighteen years old, in a family in

* Webſter's Collection, p. 197.

† P. 84 & ſeq.

the ſkirt of the (Hartford) town. He was violently attacked with moſt of the characteriſtic ſymptoms of yellow fever, &c. The next day a ſecond was taken in the ſame manner; and, on the morning of the third, three more were taken ſick. This led me to ſuſpect ſome particular cauſe. I ſearched for it in vain that time. The next morning, on paſſing through the kitchen, I ſmelt ſomething that was very offenſive, which none of the family had noticed. On opening the cellar-door, I found that it proceeded from the cellar. Two perſons went down to examine, and found, in one corner of a ſmall tight room, a quantity of June cabbages, on which the ſun had ſhone about three hours in a day. They had rotted, and ſunk down in a lump of putrefaction. They run a ſtick under them, and lifted them up, and there immediately iſſued ſuch an intolerable ſtench, as obliged them inſtantly to leave the cellar. A vomiting was brought on at once, which laſted them nearly an hour. Notwithſtanding that the doors and windows of the cellar were thrown open, it was two days before they could clear it out. No other perſon in the family was taken afterwards, and thoſe who were already ſeized ſoon recovered."

The malignant epidemic, or yellow fever, which prevailed, in the ſummer of 1797, in Providence, Rhode-Iſland; in 1795, in Norfolk, Virginia;* and, in 1791, in New-York, evidently took their origin from gaſes exhaled from vegetable and ani-

* Webſter's Collection, p. 148 & ſeq.

mal ſubſtances, ſuffered to collect and putrefy, on expoſure to a heated atmoſphere. It would be endleſs and unneceſſary to add facts in further confirmation of the noxious and deleterious qualities of certain gaſes, formed from vegetable and animal putrefaction, on its application to the conſtitution. Thoſe already related, as well as various other inſtances, ſufficiently confirm, that the greateſt degree of vitiation which the atmoſphere manifeſts by its operation upon the conſtitution, proceeds from the effluvia emitted from certain vegetable and animal ſubſtances during putrefaction. And, as far as the innumerable facts on this ſubject have been collected and examined, there exiſts the moſt cogent evidence, that the products juſt named form infection, or contagion, marſh-miaſmata, or human effluvia, or whatever other name has been affixed to it. What the preciſe nature of theſe exhalations, or cauſe of fevers, was, and which the particular noxious gas, though long a ſubject of inquiry, remained unknown, till, within a few years ſince, Mitchill, Profeſſor of Chemiſtry, Natural Hiſtory, and Agriculture, &c. in Columbia College, engaged in an inveſtigation of its properties, made known to the world what that poiſonous ſomething, which is formed during animal and certain vegetable putrefaction, was. He diſcovered it to be a portion of ſepton (azote), one of the elements of the body undergoing putrefaction, united chemically with more or leſs of oxygene (the acidifying principle), in the form of ſeptic (nitric) oxyd and acid.* On

* Vide Mitchill on Contagion.

the formation and preſence of this compound, it is preſumed, do peſtilential and other malignant diſeaſes depend. And, in proportion as a greater or leſs quantity of the above compound is formed; in proportion to its ſparſe or concentrated ſtate; in proportion to the length of time, the ſuſceptibility of the conſtitution to be operated upon, and the circumſtances under which it is applied; will the diſeaſes, depending upon this cauſe, be more or leſs violent, and attended with various peſtilential ſymptoms.

CHAPTER III.

Inquiry into the Hiſtory, Production, and Qualities, of that Acid which attends the Putrefaction of ſuch Bodies as give Riſe to malignant and peſtilential Diſeaſes.

SEPTON, the baſe of the acid of putrefaction, or ſeptic acid, is one of the moſt abundant elements in nature: it has not hitherto been ſubjected to any examination by itſelf, as no experiments have been able to detect it in a diſtinct and ſeparate ſtate. In combination with caloric (the matter of heat,) it forms ſeptous (azotic) gas, which compoſes nearly three fourths of our atmoſphere, and is the ſame ſpecies of air which living plants are ſuppoſed to exhale in the night, according to Ingenhouz.* It likewiſe

* 2 Experiences ſur, &c. ſect. vii.

conſtitutes one of the elementary principles of certain plants: and, from the reſult of certain experiments made by Eagleton Smith, Eſq.* appears to be one of the elements which compoſe animal poiſons, as was, ſome time previous to this, preſumed by Profeſſor Mitchill. From the ſimilar action on animals, of ſuch animal poiſons as were uſed by the experimentor, ſuch as that of bees, ants, and ſome other inſects, with the decoction of the poiſonous plants, laurel, tobacco, digitalis, opium, &c. it appears highly probable, that their deleterious qualities are owing to a modification of this ſame principle, viz. ſepton. It alſo enters largely into the compoſition of the muſcular fibre, blood, and lean parts of animals, in combination with carbone, hydrogene, and phoſphorus, which are united together by a certain portion of oxygene, forming animal oxyds and acids, in proportion to the degree of oxygenation. This gas, in its pure and diſtinct form, is incapable to ſupport reſpiration and combuſtion; while it ſuſtains the life of plants, which appear to poſſeſs the power of decompounding it, and to attach to themſelves the ſepton, which enters into and conſtitutes one of their principles.† This principle, or element, is alſo capable of uniting with oxygene, the principle of acidity, forming with it, in proportion to the quantity of this laſt ſubſtance, 1. The gaſeous oxyd of ſepton (dephlogiſticated nitrous air); 2. Septic (nitrous) gas; 3 and 4. Septous

* Vide Appendix A.

† Mitchill on Manures. Med. Repoſ. vol. i. No. 1.

and ſeptic (nitrous and nitric) acids; and, 5. Septic acid gas.

1. In the firſt of theſe forms, that of the gaſeous oxyd, in which the acidifying principle is ſo ſmall as not to manifeſt the ſmalleſt degree of acidity, it is capable of ſupporting combuſtion, but is highly deleterious to the lives of animals, which it deſtroys the moment they are ſurrounded by an atmoſphere of this kind.* 2 and 3. The next degree of combination of oxygene with ſepton, is the ſeptic gas, and the ſeptous acid. Theſe are artificial productions, and never found to exiſt in the atmoſphere for any conſiderable length of time, as their exiſtence depends on being kept cloſed, and free from contact with the air. The rapidity with which they abſorb oxygene from the atmoſphere, on expoſure, is ſo great as to become quickly ſaturated with this principle, and turn to ſeptic acid. As their exiſtence in the air is only momentary, unleſs kept from coming in contact with it, they can have no material influence on man or brute animals; and their qualities are ſo widely different from thoſe of the more highly oxygenated form, the experiments and concluſions drawn from the two former, cannot apply to account for the phenomena of the latter. 4 and 5. The ſeptic acid, which is ſtill higher doſed with oxygene, and the ſeptic acid gas, the higheſt degree of oxygenation of ſepton, the form in which theſe compounds moſt commonly exiſt, and which are produced wherever ſepton and oxygene

* Prieſtley on Air, vol. ii. p. 35.

come into chemical union, have, for a length of time, been conſidered of *mineral* origin, and claſſed among the acids of this kingdom. How far this opinion is founded in experience, and deduced from facts, will appear on examination of the materials, and ſources, from whence it is derived. It is well known that nitre conſiſts of ſeptic acid joined to pot-aſh, and is uſually formed during the decay of animal and ſuch vegetable bodies as contain ſepton. And it is aſcertained, that ſepton and oxygene enter into the compoſition of thoſe ſubſtances, when alive, and have gone into new combinations, on their diſengagement, after death. One of theſe recent compounds muſt be ſeptous and ſeptic acid, conſtituting, by junction with a ſaline baſe, the ſeptite of pot-aſh. The theory of ſalt-petre thus neceſſarily preſumes the generation of ſeptous and ſeptic acid, from two of the elements diſengaged from organic texture. And as ſepton, the radical of the acid, is eſpecially abundant in animal bodies, there is little difficulty in comprehending both how, in ſuch circumſtances, it attracts the acidifying principle, and afterwards attaches itſelf to the alkali. Nicholſon obſerves it to be well known, that the ſeptous acid, inſtead of exiſting in the mineral kingdom, is almoſt always produced by a concurrence of circumſtances, chiefly conſiſting in the expoſure of putrefying ſubſtances to the atmoſphere; and that it is formed by the union of two principles, which are always found in atmoſpheric air, and the exhalations of putrefying ſub-

ſtances.* The nitrous quality of the earths at the bottom of graves, in which animal diſorganization has taken place, is further teſtimony of the origin of this acid, as in this caſe it could not have acquired its ſeptic quality from any other ſource. Hence may be underſtood how other earths, ſuch as thoſe of ſtables, cow-houſes, cellars, vaults, drains, ſinks, &c. &c. acquire their nitrous quality. During the putrefactive proceſs of ſuch vegetable bodies as contain ſepton, and animal matter, which abounds in this principle, the oxygene derived either from the corrupting bodies themſelves, from the water in or near them, or from the atmoſphere, unites with this principle, and forms the ſeptic acid, which, being taken up by theſe earths, converts them into nitrous ſoils.

In further confirmation of the origin of this acid, may be added the authority of Fourcroi, who ſays, "It is no longer to be doubted that the ſalt-petre, which forms itſelf under our eyes, in ſoils ſoaked by vegetable and animal juices, or in ſtones impregnated with the ſame juices, or their vapour, (the materials which compoſe the floors and walls of our ſtables, vaults, &c.) repreſent, in this reſpect, real artificial nitre-beds."†

This acid is alſo found to exiſt occaſionally in the atmoſphere. The experiments of Margraff‡ on ſnow and rain-water, and Bergman's analyſis of waters, prove its preſence in the air, from whence

* Nicholſon's Chemiſtry, p. 32.

† Vide Med. Repoſ. vol. i. No. 1. p. 71.

‡ Vide Watſon's Chem. Eſſays, vol. ii. p. 79.

they are precipitated by theſe bodies, and mix with them in their deſcent. The nitrous quality of the calcareous matter of old walls, which takes place to ſuch an extent as to be converted to economical purpoſes, affords like proof of its preſence in the atmoſphere.

The baſes of the two gaſes, ſepton and oxygene, which compoſe this acid, conſtitute likewiſe our atmoſphere, but in different proportions and combinations. The ſeptic acid is found to contain four parts of oxygene and one of ſepton, chemically united; while the proportion of theſe ingredients in atmoſpheric air about the mean ratio, are 27 of the former to 73 of the latter; not, however, chemically united, but only diffuſed through each other, as clay is diffuſed through water, or as motes are ſeen paſſing through ſun-beams. Theſe gaſeous components of the atmoſphere are intimately blended, and mixed together, but do not loſe their attraction for caloric, by which they are continued in this ſtate, and for which, in ordinary circumſtances, they have a greater affinity ſeparately than for each other. It is by virtue of this attraction for the matter of heat, that they are each kept in a ſtate of gas, and not ſuffered to unite, and form ſeptic acid, and thereby deſtroy the reſpirability of the atmoſphere.

Dr. Beddoes remarks, that "the nice balance of attraction between the conſtituent parts of the atmoſphere deſerves notice. Theſe two ſubſtances, when cloſely united, form nitrous (ſeptous) acid; if, therefore, they were not, by ſome circumſtances,

prevented from uniting closely, all the oxygene, with part of the azote (septon), would be changed into a highly concentrated acid, and the waters of our globe would be converted into aqua-fortis," (septous acid).* Fourcroi also observes, "that this (septic) acid is composed of the same elements with atmospheric air, only under a different form, and in different proportions, from those which constitute the atmosphere. These facts are indisputably established by experiments in which the nitric (septic) acid is decomposed, and again produced by the union of the original elements. Hence it is demonstrated, that it consists of four parts of oxygene, and one of azote (septon). But these two principles, as contributing to the formation of the atmosphere, are in the proportion of a little more than two parts and one half of the first, and one of the second, and exist in an uncombined state, separately dissolved in a common menstruum, and without the possibility of contracting a real chemical union. Hence it arises, that atmospheric air is never spontaneously converted into nitric (septic) acid."†

The formation of septic acid in the atmosphere seems, however, to take place under certain circumstances; as when the two constituent elements of the acid are brought into close union, and within the sphere of each other's attraction, by some violent concussions, such as lightning in thunder-storms. The experiments made by Mr. Cavendish,‡ who,

* Considerations on the Medicinal Use, and on the Productions, of Factitious Airs, p. 18.

† Vide Med. Repos. vol. i. No. 1. p. 68 and 69.

‡ Chaptal's Chem. vol i. p. 219.

by paſſing the electric ſpark through a portion of oxygenous and ſeptous (azotic) gaſes, obtained this acid, further tends to corroborate this opinion, and leads, at leaſt, to a belief, that this proceſs, to a larger amount, is conſtantly taking place in the upper regions of our atmoſphere, by the intervention of the electric matter.

CHAPTER IV.

Action of this Acid and its Oxyds upon Timber, Metals, Earths, alkaline Salts, and Water.

THE ſeptic acid having been ſhewn, in the preceding chapter, to owe its origin to animal and vegetable decompoſition, its operation on timber, metals, &c. will next be conſidered.

Facts, ſufficiently numerous, prove that this acid, generated by putrefaction, is always on or near the ſurface of the earth, and from thence, when exiſting in any conſiderable quantity, pervades the atmoſphere, and, on meeting with certain bodies, unites with them, and becomes fixed or decompounded. If, in its vaporific form, it meets with the woody portion of dwellings, around and in which it is more or leſs plentifully evolved, more eſpecially the unclean, there can be no doubt but a quantity of this acid is imbibed, as all theſe materials are porous in a greater or leſs degree. There are no direct experiments, however, which prove

that there exiſts a chemical union between the acid and it; but, from the readineſs with which wood is penetrated by water, and the known union which this latter body poſſeſſes for contagion, it muſt not unfrequently be conveyed in this manner, and combined with the timber of human habitations, where theſe gaſeous vapours, extricated during vegetable and animal putrefaction, abound: the quantity taken up will, in all probability, be proportionate to the poroſity of their texture; and in this ratio may the different kinds of wood be capable of imbibing the acid. The rapid decay and rotting of the timber of ſuch veſſels as carry wheat, is further teſtimony of the union and deſtructive operation of this acid, on its application to wood. The manner in which this proceſs takes place, appears to be owing to the grain falling through the flooring of the veſſel, where, on mixing with the water there commonly preſent, putrefies.

Wheat, containing the principle of putrefaction in no ſmall quantity, has, during its diſſolution, this principle, united with a ſufficiency of the oxygene, ſupplied either by the water, or what it itſelf contained, to form the ſeptic acid, which, ſpreading itſelf, attaches and unites with the timber, cauſing it to rot and decay, more or leſs rapidly, in proportion to the ſtrength and activity which the acid attains.

From this diſpoſition of the acid of putrefaction to combine and unite with the woody portions of dwellings, ſhips, or whatever elſe it comes in contact with, may it happen, that the noxious matter,

ſaid, in ſome veſſels, to infect each ſucceſſive crew, derives its poiſon.

2. The operation of the ſeptic acid, as above obſerved, in rotting and breaking down the timber of veſſels, has been noticed to ruſt and corrode, proportionally quick, ſuch iron ſpikes and nails as were expoſed, in a ſimilar manner, to the ſame cauſe; and, from its corroſive qualities, gradually deſtroys and wears them away, if preſent in ſufficient quantity, till nothing but ruſt is left remaining. Such inſtances as have been collected and examined on this ſubject, go to prove this operation of the acid on metals. It has been obſerved, that in the Weſt-India Iſlands, where putrefaction goes on rapidly, ſuch iron cannon as were expoſed to the atmoſphere, commonly ſurcharged more or leſs with this acid, ruſted much ſooner than thoſe which had been buried in the ſand in ſalt water. The teſtimony of Van Sweiten alſo corroborates the activity and deſtructive influence of this acid on metallic bodies. He mentions, that at Oczakow, during the plague, "the inſtruments made uſe of by the ſurgeons turned as black and livid as if they had been dipped in aqua-fortis," (ſeptous acid)—and "the ſilver hilt of a ſword, which, all the time of the plague, hung up in a tent, was changed quite black."

3. The action of this acid, in reſpect to earths, is more obſerved, and takes place to a larger extent. It readily unites with calcareous earth (lime), whenever they come within chemical attraction, in the form of a ſeptite of the ſame, (calcareous nitre,) as appears from the nitrous quality of old walls of

privies, ſinks, drains, &c. Grounds frequently trodden by cattle, and impregnated with their excrements, the walls of ſlaughter-houſes, and the like, where exhalations from putrid animal and vegetable ſubſtances abound, as well as the formation of nitrous earths at the bottom of graves in which animal bodies have decayed, puts it beyond diſpute, that theſe earths have an attraction for and uñite with this acid. This affinity between the acid of putrefaction and lime, takes place to a greater or leſs extent in every habitation, more eſpecially in large and crowded cities, where the ſtricteſt attention is not paid to remove all filth, and putrefying animal and vegetable materials. It was ſo well known, as to become an object worthy the attention of a body corporate in Paris, who obtained licence to take away as much of the old mortar of the walls of houſes, torn down, as they pleaſed, for the expreſs purpoſe of making nitre. Hence may be learned the quantities of ſeptic poiſon that is preſent, and floats about the habitations of man, gradually undermining his conſtitution, and cauſing malignant diſeaſes, if not taken out of circulation, and combined with ſome ſubſtance.

4. This acid likewiſe, on meeting with the carbonates of alkaline ſalts, decompoſes them, by deſtroying the chemical affinity ſubſiſting between them and the weaker acids; while, at the ſame time, it attaches to itſelf the alkaline baſis, forming with it a ſeptite of the ſame. The facts already quoted, in the firſt chapter, put it beyond doubt, that the acid of putrefaction readily unites with

pot-aſh, ſoda, and ammonia, reſpectively, in the form of ſeptites, wherever they come within the ſphere of each other's attraction: and, if it is evident that theſe bodies enter into combination, there will be no difficulty to ſhew, that this acid likewiſe unites with ſuch ſalts as have an alkali for their baſe. According to Bergman's tables of elective attractions, the ſeptic (nitric) acid has a greater affinity for pot-aſh than for any other alkali; and that no acid but the ſulphuric will diſſolve their union.* On coming, therefore, in contact with ſuch ſalts as have this alkali for their baſis, it will decompoſe them, and, from its ſuperior affinity for this latter ſubſtance, combine with it in the form of a ſeptite of pot-aſh. In the ſame manner will thoſe ſalts, having ſoda and ammonia for their baſis, be operated upon by this acid.

5. The preſence of this acid in water, and its ready and entire miſcibility with this body, is evident from the experiments made, with the utmoſt diligence and attention, by Bergman and other chemiſts, on rain and ſnow water. The teſtimony of Lewis is further confirmation of this union between the two bodies. He obſerves, that "common waters, both atmoſpherical and ſubterraneous, contain a little of this acid in combination with it;"† and

* Although the ſeptic acid does not poſſeſs an attraction for either of the alkalies, in ſo eminent a degree as the ſulphuric, according to Bergman's tables of elective attractions, yet, from his note, it appears it is capable to diſengage the ſulphuric acid, in ſome caſes, partially, from its connection with alkalies, though not ſo rapid and entirely as either of the other acids.

† Materia Medica, vol. ii. p. 120.

that among the ſubſtances commonly found in waters, is the "nitrous (ſeptous) acid, combined with an alkali into nitre, or with ſome of the ſoluble earths into nitrous ſalts."* "The pureſt of the common waters is that of ſnow; and the ſaline matter of this kind of water is commonly of the nitrous kind, compoſed of the acid of nitre (ſeptic acid), united with calcareous earth."

It is agreed upon by almoſt all obſervers, that the vapours from ſtagnant waters do ſeldom occaſion much miſchief, as long as the mud and ſlime remain covered. The reaſon of this is obviouſly owing to the mud, while covered by the water, emitting its poiſon but ſlowly, which, as it ariſes to the ſurface, mixes with the incumbent water, and remains united with it, ſo that little or none eſcapes to taint the atmoſphere. But at length, as evaporation goes on, and the water is nearly evaporated, theſe fluids, rarefied by heat, and becoming volatile, aſcend into the atmoſphere, and taint it with their noxious qualities, to the detriment of man and brute animals, who live and move in it. On this miſcibility of ſeptic, or acid of putrefaction, with water, no doubt, does it happen, that ſhowers of rain, as obſerved by almoſt every writer on the diſeaſes of hot climates, poſſeſs ſuch beneficial and ſalutary effects. The rain, in its deſcent, meets with this acid, unites with it, and thus precipitates it again to the earth, leaving the atmoſphere in a ſtate freed from its poiſon. In the ſame

* Vol. i. p. 118.

manner may dews and fogs, in their deſcent, unite with this acid vapour; and to the gradual and ſlow precipitation of water from the air, falling through this infectious fluid, and carrying a portion of contagion along with it, does it happen, that the crews of veſſels, ſent on ſhore, and ſleeping on or near the ſurface of the earth, in the open air, in ſuch places where theſe peſtilential vapours abound, are ſo commonly ſeized with diſeaſes which deſtroy their lives. The natives of the Eaſt-Indies are ſo well aware of the noxious qualities, at times, of rain-water, which falls firſt in ſhowers, that they are cautious how they expoſe themſelves to it. As evidence of this atmoſpherical water containing ſomething deleterious, it has been known to cauſe ſoal-leather to become mouldy and rotten in the ſpace of forty-eight hours. The ſame was alſo obſerved to happen in our own city, in the time of the epidemic, in 1795. Hunter alſo remarks, that expoſure to rain is believed to be the cauſe of fevers in the iſland of Jamaica. The practice among Europeans at Conſtantinople, Grand-Cairo, and other places where the plague rages, to cleanſe all their goods, &c. they receive by means of water, is further corroboration that peſtilential gas unites with water, inſomuch that theſe bodies, thus cleanſed, are deprived of communicating any poiſon they had previouſly imbibed. To this miſcibility of contagious fluids with water, may cold bathing, in malignant diſeaſes, owe its beneficial and ſalutary effects—the poiſon which adhered to the ſkin and its pores being

thereby conveyed off, and rendered harmleſs to the conſtitution.

From the preceding facts, then, it may be concluded, that the ſeptic acid, generated in all filthy and unclean dwellings, ſinks, &c. on meeting with either of the ſubſtances above enumerated, unites with them, becomes fixed or decompounded, and thus taken out of circulation. By this wiſe proviſion of nature, the acid of putrefaction, which muſt be formed in no ſmall quantity, conſidering the immenſe and incalculable maſs of vegetable and animal matter which is continually undergoing diſorganization, is arreſted and reſtrained from aſſuming its corroſive, ſtimulant, and poiſonous qualities, which it exerts on man and brute animals, when ſet looſe in the atmoſphere.

CHAPTER V.

Effects produced by it upon the Conſtitution of Men, particularly the Mouth, Throat, Alimentary Canal, exterior and pulmonic Surface, Heart, Blood-veſſels, and Lymphatic Syſtem.

HAVING aſcertained, as it is hoped, the cauſe of moſt endemic and epidemic diſeaſes, the ſources of their origin and formation, together with their affinities and action on different bodies; their effects on the living conſtitution ſhall next be conſidered.

1 and 2. The effects of oxyds and acids of this ſort, when applied to the living body, which, in ſome inſtances, may be completely ſurrounded by an atmoſphere highly charged with theſe gaſeous fluids, are inflammations or ulcerations, together with many other diſeaſes of different kinds; and, if inſpired in a concentrated ſtate, may cauſe inſtantaneous death. On its application to the fauces and throat, from its cauſtic and corroding nature, it may inflame, and excite heat and diſtreſſing pain in the ſurrounding parts, and bring on apthæ, and erythematic affections of the pharynx and æſophagus, as is obſerved to happen under certain circumſtances where it is generated, or preſent, from any other cauſe, in ſufficient quantity. The experiments of Profeſſor Mitchill,* in his courſe of lectures, in 1796, on the tartar of the teeth, ſhews that this acid may be (and is occaſionally preſent in the mouth) either formed from the remains of corrupting food, or taken in, by inſpiration, with atmoſpheric air. This operation and effect, produced by the acid and its oxyd, on the fauces and throat, is further confirmed by facts of diſeaſes of theſe parts, induced by breathing air highly vitiated with peſtilential effluvia. To this effect is the obſervation of Huxham, who remarks, that "for many months paſt we had ſcarce the ſlighteſt fever, but it was attended with ſore-throat, apthæ, and ſome kind of cuticular eruption, and that, too, in pleuritic and pneumonic diſorders; ſo greatly did the conſtitu-

* Vide Mitchill's letter to Thomas Charles Hope, M. D. in the New York Mag. for February, 1797.

tion of the air, &c. ſeem diſpoſed to produce eruptions in all ſorts of feveriſh indiſpoſitions."*

Robertſon, in his remarks on the Monthly Review of the ſick in July and May, alſo obſerves, that to the claſs of fever, the dyſenteric belly-ache, and almoſt all the cough and ſore-throat caſes, ſhould be added, becauſe they originated, I had nearly ſaid, from the ſame ſource; theſe different appearances depending on the habits or conſtitutions of the ſubjects infected."†

In the peſtilential fever which prevailed at Wincheſter Hoſpital, many were ſeized with uneaſineſs of ſwallowing, and complained of a ſoreneſs of the throat.‡ To this may be added the authority of Chiſholm, who, in his account of an epidemic fever in Grenada, remarks, among other obſervations, that "ſome complained of a rawneſs, as it were, from the throat to the ſtomach;" or, as they expreſſed it, "a rawneſs and burning of their inwards."§

Hence, then, it will appear, that this volatile acid does occaſionally enter the fauces, and extends its influence to the æſophagus, cauſing a greater or leſs degree of inflammation and uneaſineſs in the parts, according as the poiſon is in a more or leſs concentrated form, and to the length of time it is applied. The mucus which lubricates the parts, and is continually excreted in conſiderable quanti-

* On Fevers, p. 274.
† On Jail Fevers, p. 325.
‡ Smyth on Jail Fever, p. 12.
§ Med. Com. for 1792, p. 267.

ties, more eſpecially on the introduction of any extraneous body, may, in all probability, defend them from more repeated attacks of this acid, by uniting with, and preventing its coming in contact with the parts.

3. The operation of this acid on the ſtomach and inteſtines appears more frequent than the above, and is productive of greater evils and fatality to the conſtitution. It may be either taken into the ſtomach by mixing with the ſaliva, and ſwallowed, or may be generated in the inteſtinal canal, on the putrefaction of ſome of thoſe ſubſtances that are taken in for our nouriſhment. The opinions of the moſt reſpectable authorities countenance theſe modes of operation. The ſaliva and fluids of the mouth conſiſt principally of water, and may, therefore, be ſuppoſed to poſſeſs an attraction for theſe contagious gaſes. The infection, thus finding its way into the mouth, will almoſt unavoidably get into the ſtomach during the deglutition of our food, or be conveyed there with our drink.

Balfour, in a Treatiſe on Putrid Inteſtinal Remitting Fevers, aſcribes the cauſes of theſe complaints to a putrid ſtate of the *mucus lining the inteſtines*, which, being abſorbed by the lacteal veſſels, and carried into the blood, cauſes the febrile ſtate. —"This mucus receives the infection firſt by contagious matter taken into the ſtomach by means of the ſaliva."*

To this may be added the authorities of Turner,

* Page 130.

Gardiner, and Lind; the latter of whom ſays, that ſwallowing the ſpittle, in infected places, is juſtly deemed a means of ſooner acquiring the taint; for which reaſon neither the nurſes, nor any one elſe, ſhould be ſuffered to eat in infected hoſpitals. "I am apt to think, that infection, from whatever impure fountain it is derived, does firſt diſcover itſelf by affecting the ſtomach and inteſtines."*

Another mode in which the diſeaſes depending on the ſeptic acid are generated, is by the putrefaction of thoſe ſubſtances taken into the ſtomach, from time to time, for our ſupport. If it is evident, that animal and vegetable matter, undergoing diſſolution in the open air, give riſe to the ſeptic acid and its oxyds, is it not preſumable, that this ſame compound will be formed, on the corruption of ſimilar ſubſtances, in the *primæ viæ* of human bodies? It is neceſſary to the maintenance of life, that a proper quantity of food be taken into the ſtomach, from time to time; and that the digeſtive organs perform their functions properly; for, as the diet is principally of the animal kind, and, conſequently, containing all the elements neceſſary to the formation of the ſeptic compounds, it would undergo putrefaction in the inteſtinal canal, were it not prevented by the ſaliva, gaſtric liquor, pancreatic juice, and bile, which, mixing with it, diſſolve and prepare it for the various purpoſes it is intended to anſwer. As long, then, as the ſtomach ſecretes its liquors in healthy and due

* On Hot Climates, p. 65.

quantities, will its contents be kept in utter impoſſibility of forming the ſeptic poiſon. But when theſe preventatives are entirely ſuſpended, or weakened, from debilitating cauſes, ſuch as the too liberal uſe of ſpirituous liquors, exceſſive heat, fatigue, or from any other proceſs by which its healthy functions are deſtroyed or impaired, then it is evident that the food will be liable to corrupt, and the products formed from theſe materials, within the ſtomach and inteſtines, ſimilar to thoſe which obtain without the body. A ſource of poiſonous effluvia ſeems thus to exiſt in our bodies; and, from its ſtimulant qualities, the occurrence of nauſea, burning pain, and exceſſive vomiting, together with other ſymptoms of gaſtretis, will not be difficult of explanation. To this cauſe, whether generated in the *primæ viæ*, or taken in from a vitiated atmoſphere, when applied to the inteſtinal canal, are diarrhœas, dyſenteries, and cholera morbus, diſeaſes of the ſame genus, only differently modified, referable. The inflamed ſtate of the ſtomach, duodenum, and lower parts of the inteſtinal canal, and the black gangrenous and mortified ſpots, are all owing to the operation of this acid, which, in ſome caſes, may acquire a higher degree of malignancy than common, by uniting with a larger portion of oxygene. The coffee-coloured matter, commonly called *black vomit*, ejected in what are called *bilious remitting* fevers, ſeems to owe its colour to a mixture of this acid, as appears from its ſtimulant nature, noticed by diſſectors, with a quantity of bile and blood, which is poured out of ſuch veſſels as have

their coats deſtroyed by this poiſon. That this is not a diſcharge of putrid bile, is evident from the experiments of Saunders, who obſerved, that ſo far from its becoming putrid, it was leſs liable to undergo this proceſs than any other of the animal fluids, and would even prevent the diſorganization of ſuch ſubſtances as were immerſed in it.* Blood, mixed with bile, became putrid in three days; while no mark of putrefaction manifeſted itſelf in the bile till the ſixth day.† Hence alſo it is evident, that putrid bile, which has been aſſigned as the cauſe of bilious fevers, has no agency in its production; for if the bile did, in reality, become putrid, this change muſt neceſſarily have previouſly taken place in the blood, in which ſtate the animal muſt expire within a few moments after putrefaction takes place.

4. On the application of theſe peſtilential fluids, which have been conſidered the cauſes of the diſeaſes mentioned, to the bodies of men, which it may completely ſurround in ſome caſes, is it preſumed, are the various eruptions and petechiæ, ſo common in fevers of the worſt type, to be explained; and not often to be referred to critical depoſitions of humors from the blood. Theſe affections will put on different appearances and malignancy, in proportion to the concentrated ſtate of the poiſon, the conſtitution, and parts to which it is applied. From the diſpoſition of this acid to adhere to bed-clothes

* On the Liver, p. 130.

† On the Liver, p. 110.

and bedding, of which there are innumerable inſtances, it will readily appear how theſe peſtilential eruptions are produced, eſpecially on thoſe parts that are kept conſtantly covered, as the back, loins, &c. which are thus continually ſurrounded by an atmoſphere of contagious vapours. The ſkin, thus beſet by this fluid, whoſe particles ſeem to inhere in its pores, becomes inflamed, and puts on this morbid appearance. The yellow colour of the ſkin, in ſome caſes of highly contagious diſeaſes, ſeems to depend upon the ſame cauſe, and not to an abſorption of bile, as has been ſuppoſed by writers on bilious remitting fevers. If theſe changes of colour in the ſkin were really owing to abſorbed or to regurgitated bile, the colour of the urine, in theſe caſes, ought to be deeply tinged with this fluid, and the fæces to put on an aſh-coloured appearance, as in jaundice; but none of theſe appearances are obſerved to take place in the fevers where this pretended abſorption is alledged. Beſide, it is well known, that ſuch parts of the ſkin to which this poiſon is artificially applied, will put on a yellow appearance, reſembling that which is obſerved to take place in what is called *yellow* fever. It has been obſerved, that perſons ſick with this fever, which had been taken in the Weſt-Indies, had that part of their eyes which was, in viſion, expoſed to atmoſpheric air, tinged with yellow; while the remainder of the eye retained its natural colour. In this caſe the eye could not have acquired this colour from an abſorption of bile; which, if it had been the caſe, would alſo have been evident in

other parts of the eye and body. Were it not, probably, for the perpetual ſupply of tears, which waſh the eyes, and thus convey off any contagious fluids that may be applied, theſe appearances might oftener occur, as impreſſions would be quicker obſerved in this organ than on the ſkin.

5. This acid, in a vaporific form, does, no doubt, ſometimes enter the trachea, with the air, in reſpiration, where it may inflame and deſtroy the parts with which it comes in contact; and, in its paſſage to the lungs, if in a concentrated form, may occaſion ſudden death. In this manner may the ſudden extinction of life, in perſons expoſed to the contagion of the plague, as obſerved by Ruſſel, be accounted for.* If this gaſeous fluid be inſpired in ſuch a diluted ſtate as not to occaſion immediate death, it may cauſe catarrhal affections, anxiety, coma, ſuffocation, &c. depending on the ſparſe or concentrated form, and circumſtances under which it is applied. When mixed with atmoſpheric air, and taken into the lungs, it will not ſerve the purpoſes of reſpiration, as but a ſmall portion of vital air will be decompounded, owing to the large quantity of non-reſpirable air which is taken in. The heat of the body muſt thereby be leſſened, and the contractions of the heart and arteries become more ſlow and feeble. In this way may the purple and blackiſh ſpots of perſons dead of fever, occaſioned by this acid and its oxyd, and the livid and dark colour of the ſkin, attended with

* Hiſtory of Aleppo, p. 232.

coldneſs during life, be accounted for; the lungs not being able to reſtore to the ſyſtem its uſual and neceſſary ſupply of oxygene. Hæmorrhages, debility, and proſtration of ſtrength, together with want of coheſion in the ſolids, might all be explained upon the ſame principle, the muſcles being deprived of their uſual quantity of oxygene, and overcharged with ſepton.

6. If this acid be formed in the ſtomach and inteſtines, or taken in by the ſaliva, and applied to the mouth, fauces, cuticular and pulmonic ſurface, can it be ſuppoſed, that it ſhould not be taken up by the abſorbent veſſels of the ſkin and pulmonic organs, or abſorbed by the lacteals of the inteſtines, which are known, in ſome inſtances, even to take up ſome of the fæces, and carried into the maſs of blood? That ſomething of a peſtilential nature is conveyed into the blood, appears from the evident marks of peſtilential infection, which children, born of mothers ſick with the plague, bring along with them. Whether they acquired this taint immediately from the blood circulating through the umbilical cord, or from the *liquor amnii*, or both conjoined, is immaterial to our preſent purpoſe, as, in either manner, it goes to prove what has been ſaid above. The acid ſweats thrown out from the poiſoned maſs of blood, by means of the ſmall exhalent arteries, in malignant and peſtilential diſeaſes, forming the matter of contagion, and adhering to the bed-clothes and linen, which, by its coroſive qualities, it deſtroys and rots; and, if excreted in any conſiderable quantity, ſo commonly re-

lieves the patient; inaſmuch as the volume of poiſon contained in the arterial ſyſtem is thereby leſſened; ſhews that the blood, in certain diſeaſes, contains ſomething of a noxious nature. The appearances alſo which blood, drawn in peſtilential fevers, puts on, correſpond with that in which ſeptic gas had been artifically injected.* Blood, thus infected with this poiſon, taken up by the abſorbent veſſels, will be carried the round of circulation, and will continue to ſtimulate the heart and arteries, wearing out their excitability, and, conſequently, bring on death, if the conſtitution is incapable of becoming habituated to its ſtimulus, or part, or whole, of the ſtimulus be not ſubducted. If it be preſent in any great quantity, it may cauſe a ſudden extinction of the vital principle, as is obſerved ſometimes to happen in highly peſtilential diſeaſes.

7. The above-mentioned compounds, when abſorbed by the lymphatics, may inflame them, and cauſe obſtructions, indurations, and even ſuppuration, of thoſe glands through which they paſs, as is commonly obſerved to take place in the inguinal and axillary glands, in the plague, and other diſeaſes produced by a peſtilential ſtate of the atmoſphere, where it is abſorbed in a highly concentrated form. Inſtances have occurred, where the lymphatics of the hand, on this extremity being wounded, in diſſecting bodies, in which the ſeptic acid appears already to be formed, were highly inflamed, and

* Vide Mitchill on the effects of contagion on the heart, in the New-York Mag. for 1796.

could be readily traced from the part where this fluid had been applied, in their courſe to the glands in the axilla, in which ſubſequent ſuppuration took place. Beſide the affections of theſe glands, thoſe of the meſentery will be liable to like ailments; and more frequently, as this deleterious fluid will be more frequently applied to them, by reaſon of its abſorption from the inteſtines. The ſeptic compounds, paſſing through the lacteals, will inflame them, and extend to the glands, in their way to the thoracic duct, and bring on an indurated or ſchirrous ſtate: if it be abſorbed in a highly concentrated ſtate, it may alſo communicate its effects to the meſentery. When theſe glands become indurated or inflamed, the chyle will neceſſarily be obſtructed totally, or in part, in its circulation through theſe glands; conſequently the ſyſtem will not receive a ſupply of nouriſhment equal to the quantity expended in performing its healthy functions. Hence the body muſt waſte away, and the diſeaſe named maraſmus be induced. The frequent dropſical affections which follow long-continued intermittents, dyſenteries, and other diſeaſes of the ſame claſs, appear, in many inſtances, to be owing to obſtructions of theſe glands, which do not allow a free paſſage to the lymph, which is therefore depoſited in the different cavities and cellular texture of the body; and in proportion as the obſtruction is more or leſs univerſal, will the diſeaſe be general or local.

CHAPTER VI.

Application of this Principle to explain the Prevention and Deſtruction of Infection, or Contagion, in Ships performing Quarantine, in Jails, Hoſpitals, private Dwellings, in regulating the Police of Cities, in the Management of Lazarettos, &c.

HAVING ſhewn the operation of the ſeptic acid, on its application to the conſtitution, we come next to conſider its prevention and deſtruction in ſhips, performing quarantine, &c. &c.

1. In ſuch ſhips as have theſe noxious effluvia floating about, either derived from articles infected, or generated from the collection and putrefaction of ſuch materials as contain ſepton, it will be proper, from the known affinity which ſubſiſts between theſe contagious vapours and calcareous earth (lime), to expoſe this ſubſtance to an atmoſphere thus impregnated. White-waſhing between decks, and all ſuch places as may admit of this practice, will therefore be the moſt advantageous method in which it can be applied, as a larger ſurface will thereby be expoſed, and, conſequently, a greater portion of the acid taken up and neutralized in a given time. Frequent repetitions of this practice will be neceſſary where the contagion is abundant, as the lime will become ſaturated with this principle, and incapable to attract and take out of circulation any more of the noxious compound. In ſuch inſtances where theſe effluvia have, for any

length of time, been preſent in veſſels, it is more than probable, that from the capability exiſting between the two to unite, the timber of the latter may imbibe ſome of theſe vapours; and to this, as has been above remarked, may it be owing, that the ſucceſſive crews of certain veſſels are ſometimes deſtroyed. To deſtroy this connection between theſe two bodies, as well as to prevent the future aſcent of the gas, and thus again taint the circumambient atmoſphere, a ſolution of the vegetable alkali (pot-aſh), in water, which poſſeſſes the greateſt known affinity for this fluid, will be a proper preventative. It will diſengage the acid from its connection with the wood, in conſequence of this ſuperior attraction, and join with it itſelf. Frequent waſhing the apartments will likewiſe tend greatly to cleanſe and carry off the noxious vapours; and will alſo, by being imbibed into the texture of the wood, ſet looſe and convey away ſuch poiſon as may remain. Ventilation muſt not be neglected; the contaminated atmoſphere will thereby have part of its volume conveyed off, and a quantity of purer air admitted; thus rendering its ſtimulating quality leſs violent and active.

2. The ſame means, recommended above, for the deſtruction of theſe fluids in ſhips, will apply to jails.—As white-waſhing the walls with lime can at all times and readily be done here, it ought, from time to time, to be renewed; the poiſonous effluvia being thus conſtantly taken up, and rendered harmleſs. Waſhing the apartments with water or ley, which has a ſtill greater affinity for theſe effluvia, will

diſengage the poiſon which they ſo commonly become impregnated with, to the injury of the health of the inhabitants of theſe places. In no one inſtance will it be more neceſſary to admit freſh air, than in theſe places. The pent up vapours will, in a ſhort time, acquire a high degree of malignancy, and cauſe difficulty of reſpiration, uneaſineſs about the precordia, and bring on other ſymptoms indicative of a vitiated ſtate of the atmoſphere.

3. The regulation of hoſpitals will be anſwered by the ſame means already noticed for jails and ſhips: but, from the ſpecific gravity of this acid or its oxyd, it will occupy the lowermoſt parts of the rooms. "Under an atmoſpheric preſſure which ſupports the quick-ſilver in the barometer at 29. 84 inches, and in a temperature of 54. 5 of Fahrenheit, a cubic foot of azotic gas weighed one ounce, thirty grains and one half; and of oxygenous gas, one ounce, one drachm, and fifty-one grains: it is preſumable that a combination of the two, that is, thirty-ſeven parts of oxygene united to thirty-three of azote, would form a fluid of nearly the ſame weight with atmoſpheric air, or rather heavier; and the probability of this would increaſe, by conſidering that a cubic foot of nitrous gas, which contains only thirty-one parts more of oxygene than the gaſeous oxyd does, weighs one ounce, two drachms, and thirty-nine grains." Hence, then, perſons who lay on or near the floor, where this compound is preſent, will ſuffer more than thoſe who walk through theſe places; and for this reaſon alſo will the atmoſphere on the ſecond floor be

more reſpirable than that on the firſt, or loweſt. Vent-holes, upon a level with the lowermoſt part of the room, may therefore more readily ſuffer the eſcape of theſe noxious compounds; and, in addition with thoſe ſubſtances that take up and neutralize them quickly, reſtore the purity and reſpirability of the air.

4. The preventatives already mentioned, particularly for ſhips, which may be conſidered as floating habitations of men, will alſo apply to the cleanſing and purification of private dwellings. From what has been ſaid on the affinity of lime with the ſeptic acid, it will, at firſt view, appear how much more preferable, and conducive to the health of the inhabitants, ſuch dwellings, which have their walls plaiſtered with this ſubſtance, will be, to thoſe of gypſum (ſulphate of lime), which is incapable to neutralize the acid. The common practice to prevent and deſtroy contagion in private dwellings, by means of alkalies diſſolved in water, ſuch as ley, &c. and lime, ſhews how much preferable this management and contrivance is to that of burning tar, coal, ſulphur, &c. ſubſtances that poſſeſs no uſeful, but pernicious qualities, inaſmuch as the peſtilential matter reſiſts the attractive powers of theſe ſubſtances. (Vide ſect. vii).

5. In regulating the police of cities, it will, at firſt view, appear highly neceſſary, in order to prevent the formation of theſe noxious fluids, to remove all the materials, ſuch as animal and certain vegetable ſubſtances, from which they are generated. In addition to the preventatives enumerated for the

prevention and deſtruction of contagion in jails, &c. planting trees along the ſtreets, eſpecially thoſe which are, from ſituation, more liable to collections of gaſes of this kind, will be of ſervice in decompounding theſe fluids, as ſoon as formed, if in conſiderable quantities, and thus reſtore the air to its former ſtate of reſpirability. "Theſe very ſubſtances (putrefying bodies and ſtreet-manure), that cauſe ſo much miſchief and terror in *cities*, are ſought after with great avidity by farmers, who purchaſe them at a high price, and uſe them, with much advantage, to fertilize their fields. The beneficial and ſalutary effects of this practice in huſbandry, makes it look as if nitrous acid and nitrous airs were good manures, and that vegetables had the power of decompounding them. That, in ſhort, in the economy of plants, there is a proceſs by which the ſepton and oxygene of theſe infectious fluids are ſeparated; and while the former remains in the vegetable as a part of its nutriment, the ſurpluſage of the latter, after forming gum, mucus, meal, &c. and other vegetable oxyds, flies off through the upper ſurface of the leaves, in company with heat and light, in the form of vital air." (Vide Mitchill on the decompoſition of contagious air by vegetation. New-York Mag. for 1797.)

The luxuriant growth of vegetables in the ſummer and autumn of 1795, in New-York, during the epidemic, makes it further evident, that vegetables decompound this noxious body, and thus act in a beneficial and ſalutary manner. Upon this principle in vegetables to deſtroy the chemical

union between the ingredients of ſeptous airs, may the dangerous conſequences often attending the cutting down of woods in new and uncultivated countries, be accounted for. The exhalations from the ſwamps, moraſſes, &c. being ſet looſe in greater quantity in the atmoſphere, by the now more direct rays of the ſun, without any adequate ſupply of other vegetable ſubſtance to arreſt and decompound them, they aſcend, and pervade the air, carrying on their uſual noxious and deleterious qualities, on meeting the bodies of men, or brute creation.

6. The management of lazarettos may be conducted upon the ſame principle. From the known miſcibility of contagion with water, and the ſhort diſtance theſe fluids extend their influence over this body, as has been repeatedly obſerved by Lind, and others, the moſt proper and healthy ſituations for inſtitutions of this kind, are readily pointed out. And,

7. According to what has been ſaid in the fifth chapter, concerning the production of contagious fluids in the ſtomach and inteſtinal tube, from animal and certain vegetable food, taken in from time to time, it will appear, that ſuch ſubſtances as contain ſepton to any amount, ſuch as lean and muſcular animal ſubſtances, are improper ingredients in diet. Such articles, then, as contain none of this principle, ought to be ſelected as the moſt proper for nouriſhment in complaints occaſioned by this acid. Fat or oily ſubſtances being of this claſs, and vegetables containing but little ſepton, ought to be the moſt beneficial and wholeſome diet in ma-

lignant and peſtilential diſeaſes. This is authenticated by facts ſufficiently numerous to put it beyond cavil.

The comparative health, in the Weſt-Indies, between the Engliſh, who indulge in the free uſe of animal food, and the French, who, on the contrary, abſtain from this kind of aliment, and live principally on vegetable food, ſhews that animal matter is not only improper, but is an injurious article in our diet, in all peſtilential conditions of the atmoſphere, or when malignant diſeaſes prevail. The ſame is obſerved to happen in Bengal, and other parts of the Eaſt-Indies. The Engliſh, who live principally on animal and vegetable food, are far more liable to attacks of malignant diſeaſes, and a greater number of them are carried off annually thereby, than of the Gentoos and Brahmans, who live on rice. Beſide, it is well known how much leſs fatal the *yellow fever*, and other ſpecies of malignant diſeaſes, are among the negroes of the Weſt-Indies, and thoſe of the ſouthern ſtates, who live on vegetable food for the moſt part, than among the whites of theſe places, who are under no neceſſity of abſtaining from the uſe of animal food.

APPENDIX.

EXPERIMENT I.

I TOOK two mice; one I cauſed to be ſtung by a waſp, which was immediately thrown into convulſions, and expired in two minutes: into an inciſion made in the muſcular ſubſtance of the other, I injected two drops of the nitrous acid; it ſeemed to operate exactly in the ſame manner as the ſting of the waſp, and the animal expired immediately. On opening them, and endeavouring to ſtimulate the muſcular ſubſtance of their hearts, I found it had in a great meaſure loſt its irritability. Fontana obſerves, in his book upon Poiſons, that the nitrous acid, applied to the muſcular ſubſtance of a pigeon, killed it immediately; Cavendiſh and Lavoiſier have proved, by experiments, that the azote is the radical principle of the nitrous acid.

EXPERIMENT III.

I took four young puppies: into the jugular vein of one, I injected four drops of the decoction of white helebore; into the ſecond, I injected four

drops of the digitalis; into the third, I injected one grain of the ſalt of urine diſſolved in water; the fourth I cauſed to be ſtung by two waſps; the firſt died almoſt inſtantaneouſly; the ſecond and third in leſs than five minutes; the fourth recovered with great difficulty, and ſeemed to throw off the diſeaſe by foaming at the mouth.

EXPERIMENT IV.

I cauſed a number of earth worms to be ſtung by bees, ants, and other inſects, which always killed them immediately; and ſeemed to act on them in the ſame manner as the decoction of the poiſonous plants, the laurel, tobacco, opium, &c. This effect is aſtoniſhing, in theſe animals, which, when cut into pieces with the knife, ſtill retain their irritability for many hours, or even days.

All poiſonous plants with which we are acquainted ſeem to act in the ſame manner when injected into the circulating ſyſtem of animals; yet, from the nature and conſtruction of the ſtomach of ſome animals, they are eaten with impunity: goats will grow fat upon euphorbium, and ſwine upon henbane, &c.

THE END.