A medical commentary on fixed air ... / [Matthew Dobson].

A

MEDICAL COMMENTARY ON FIXED AIR:

PARTICULARLY,

I. On the different methods of procuring and adminiſtring Fixed Air.

II. On its ſenſible effects in health, taken internally.

III. On its effects in diſeaſes of the putrid claſs.

IV. On putrefaction, the putrid effluvium, and the means of correcting the putrid effluvium.

V. On the effects of Fixed Air, on the putrefactive proceſs, and on the putrid effluvium.

VI. On the uſe of Fixed Air in cachexies and phagedenic ulcers.

VII. In ſome diſeaſes of the ſtomach.

VIII. In the ſtone and gravel.

IX. On the diſpoſition to the ſtone in the cyder counties, compared with ſome other parts of England.

X. On the noxious effects of Fixed Air.

BY

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THIS

COMMENTARY,

FROM GRATITUDE AND RESPECT,

IS ADDRESSED

TO

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LIVERPOOL,
JULY 1ST, 1779.

A

MEDICAL COMMENTARY ON FIXED AIR.

INTRODUCTION.

FIXED Air has been found by ſome ingenious modern writers, to poſſeſs ſuch ſingular and powerful qualities, as to become an important ſubject of Medical and Philoſophical inquiry.

Conſidered as a ſubject of Natural Philoſophy in general, Fixed Air is eſſential to many of the operations of Nature, and when it's various properties are ſtill further aſcertained, may lead to a clearer knowledge of ſome of her more abſtruce and intricate movements.

Conſidered as a ſubject of Medical Philoſophy, Fixed Air appears likewiſe to be of extenſive importance. If we attend to the ſtate of the animal oeconomy in health, we find it preſent in the ſtomach and inteſtines, as developed by the proceſs of digeſtion; and we find alſo, from the experiments of Dr. Hales, Sir John Pringle, Dr. Macbride, and others, that Fixed Air enters very univerſally into the compoſition of animal ſubſtances. It's preſence and effects are no leſs obvious in the diſeaſed ſtate of the animal oeconomy; where the ſtomach is weak, and the digeſtion conſequently imperfect, it is exerted in a troubleſome and oppreſſive flatulence, which ſometimes degenerates into a confirmed Tympany. When combined with an animal earth, it forms the ſtone and gravel: and in mortifications, it is the ſame fluid, which raiſes the cuticle in veſications, and

encreaſes

encreaſes the bulk of the diſeaſed parts.

It might be conjectured *a priori*, that a body which has ſuch a general influence in the animal oeconomy, might be ſo directed by art, as to produce very powerful effects; and we accordingly find, that Fixed Air may be rendered the inſtrument either of health or diſeaſe, of life or death, according to the circumſtances which accompany it's application. If an animal be immerſed in a ſufficient quantity of pure Fixed Air, a total loſs of ſenſe and motion immediately enſues; and if the animal be not ſpeedily returned into common air, death is the certain conſequence. On the other hand, Fixed Air, when properly managed, promiſes very ſalutary effects in ſome diſeaſes, and may be variouſly adapted to the purpoſes of medicine.

SECTION I.

OF THE DIFFERENT METHODS OF PROCURING AND ADMINISTRING FIXED AIR.

I. Thoſe mineral waters which are briſk and ſparkling, as well as a variety of fermented liquors, are ſtrongly impregnated with Fixed Air, and are drank with advantage on this account.

II. Common water may be artificially impregnated with Fixed Air, by different methods.

1. Water may be ſaturated with the Fixed Air of chalk, detached by the acid of vitriol, according to the directions given by the very ingenious Dr. Prieſtley. *(a)*

2. Water may likewiſe be impregnated with Fixed Air, by the aſſiſtance of Dr. Nooth's elegant glaſs apparatus.

3. Dr.

(a) Directions for impregnating water, &c. by Joſeph Prieſtley, LL. D. F. R. S.

3. Dr. Prieſtley mentions another method of ſaturating water with Fixed Air, which is to take two veſſels, and to keep pouring the water from one into the other, when they are both of them held as near as poſſible to the yeſt of ſome fermenting liquor. "In this manner," ſays the Doctor, "I have ſometimes, in the ſpace of two or three minutes, made a glaſs of exceedingly pleaſant ſparkling water, which could hardly be diſtinguiſhed from very good Pyrmont, or rather Seltzer water." *(b)*

4. The Duke de Chaulnes propoſes a method alſo of expeditiouſly ſaturating large quantities of water, with the Fixed Air which is accumulated on the ſurface of fermenting liquors. A veſſel, containing eight or ten gallons of water, is to be let down and ſuſpended near the ſurface of the fermenting liquor; and the water is then to be powerfully agitated

(b) Experiments on Air, vol. 1, p. 28.

tated by a contrivance reſembling the mill of a chocolate-pot. The Duke finds that thirty or forty pints of water may, in one minute, thus be ſaturated with Fixed Air. *(c)*

5. M. Venel, late Profeſſor of Chemiſtry in the Univerſity of Montpellier, contrived, many years ago, a ſtill different proceſs for impregnating water with Fixed Air. By this proceſs the Fixed Air is transfered in a quieſcent ſtate from the alkaline ſalt, and paſſes without any ſenſible effervescenſe into water, or any other fluid in which the alkali has been previouſly diſſolved. That this proceſs may ſucceed, it is neceſſary that both the acid and alkali be ſufficiently diluted, that they be mixed cautiouſly, and the veſſel immediately well corked. *(d)* The particulars of this

(c) Journal de Phyſique.

(d) It is to be obſerved that M. Venel ſuppoſes the elaſtic fluid contained in mineral waters to be common atmoſpheric air.

this proceſs may be ſeen at large in two memoirs read before the Royal Academy of Sciences in 1750, and publiſhed in the ſecond volume of *Mèmoires prèſentès par les Sçavans e'trangers.* Or in Mr. Henry's tranſlation of M. Lavoiſier's Eſſays Phyſical and Chemical,

The nature of this volatile principle in mineral waters, and the artificial means of impregnating common water with Fixed Air, ſo as to imitate theſe mineral waters, form a curious and entertaining ſubject, which has been gradually unfolded and explained, by Van Helmont, Hoffman, Hales, Seyp, Venel, Brownrigg, Black, Cavendiſh, Lane, Prieſtley, Bewly, *&c.*

A diſtinguiſh'd modern chemiſt, the tranſlator and improver of *Macquer's Chemical Dictionary*, obſerves, that *Van Helmont* long ago aſcribed the acidulous taſte and the ſolution of iron, in mineral

mineral waters, to their *Gas* or Fixed Air. " Mr. *Lane*, ſays he, has ſhewn that the *Gas* of mineral waters is capable of *diſſolving iron*; and that by means of this fluid, without any other menſtruum, the iron is diſſolved and ſuſpended in many chalybeate waters. And indeed *Van Helmont*, long before, knew that the eſcape of the ſpirituous gas from theſe waters, by expoſure to air, was accompanied with a loſs of their acidulous quality, and a depoſition of the ferruginous matter diſſolved in them." *Appendix to the ſecond edition of Macquer's Dictionary of Chemiſtry*, page 48.

A more accurate knowledge however of this ſubject is attributed to *Van Helmont* than is to be deduced from his works; as will appear from the peruſal of his *Paradoxa de Aquis Spadanis*, and his *Tractatus de Lithiaſi*.

The

The writings of *Van Helmont* may not at this time be very generally read, the following abſtract therefore of his account of the German Spaw waters, may not be unacceptable to the reader.

Van Helmont deſcribes three volatile principles in theſe waters. 1. *The Spiritus ſulphureus.* 2. *The Vena Ferri.* 3. *The Gas ſylveſtre.*

Spadani fontes habent ſpiritum ſulphureum, manifeſte acidum, unde fontes acidi dicuntur, et venam ferri. Utrumque nempe embryonatum, immaturumque continetur liquatum, in aqua ſimplici. Lithiaſis, Caput quartum, § 3.

Both theſe principles are volatile; the firſt, the *ſpiritus ſulphureus*, he likewiſe calls *ſal eſurinum, ſulphuris embryo*, and under theſe names clearly deſcribes the volatile vitriolic acid, to which he attributes the *acidulous taſte* of theſe

waters. The *vena ferri* or metallic principle is likewiſe volatile, and is called ſometimes *vena volatilis, venæ embryo.*

As long as theſe two principles remain diſtinct, the waters retain their virtue and activity; but as ſoon as they are combined, they form a third ſubſtance, which adheres to the veſſels in the form of an ocherous or ſtony cruſt, and the waters become effete.

Mox itaque incipiunt ambo vires reciprocas in ſe mutuo conſerere. Atque tandem, cum laſſatis viribus, ſtiterint actionem ſuam, condenſantur in corpus lapideum, lagenis ſe affigens, in forma ocræ; ſicque aqua redit in priſtinum elementum, omni exuta qualitate aliena. Lithiaſis, Caput quartum, § 4.

The formation of the ochre from theſe two volatile principles, is likewiſe deſcribed in the following words. *Eſtque longe alia prorſus actio, dum duo ſpiritus*

tus in ſe invicem agunt. Nam in hac conſtituitur novum ac neutrum ens, qualis eſt ocra, ex ſpiritu ſulfuris, et venæ volatilis. Ibidem, § 5.

The *Gas* or third volatile principle, is ſeparated during the conflict of theſe two; and the entire ſeparation of the *Gas*, is only a mark of their complete union. If the waters are kept cloſe, the *Gas* does not eſcape, the two principles are prevented from acting on each other, and the waters conſequently retain their virtues. *Verum ſpadanæ ſpiritus acidi, ex embryonato ſulphure enati, bullas atque ſilveſtre gas excitant, ac tandem ſe vaſi affigunt. Alioquin enim ſi iſtud Gas nequeat eructari, aquæ ſpadanæ manent ſoſpites, medendo aptæ. Nam ſi Gas egredi prohibeatur, impedit, quo minus ſubſequens ſequatur, ſpirituſque reddantur effæti agendo. Lithiaſis Cap. quartum,* § 7.

With reſpect to the medicinal virtues

of theſe waters, *Van Helmont* aſcribes their deobſtruent qualities to the *ſal eſurinum*, and their ſtrengthening powers to the *vena ferri* or metallic principle: (e) but no virtues are attributed to the *Gas* or Fixed Air, except that of being a teſt, by which we diſcover, when the *ſal eſurinum and vena ferri* are perfectly united; and their medicinal virtues conſequently exhauſted by their action on each other. The reader will eaſily diſtinguiſh, how ingenious, fanciful, and erroneous, is this account of the German Spaw waters.

III. Another method of adapting Fixed Air to the purpoſes of medicine, is by the addition of lemon juice to ſalt of tartar, ſalt of wormwood, or any other fixed alkaline ſalt; the mixture being inſtantly drank as ſoon as the efferveſcence commences. This remedy

(e) Paradoxum quintum, § 1. & 7.

medy was directed by Riverius in the nauſea and vomitings of malignant fevers, to the great refreſhment and relief of the patient. *(f)* It does not appear, however, that Riverius attributed this happy effect to the Fixed Air, or that he was at all acquainted with the ſubject.

IV. Fixed Air may in like manner be given as detached from the volatile alkali by lemon juice; and thus adminiſtred, has the advantage of being combined with a very palatable *Spiritus Mindereri*, a medicine of well-known efficacy.

V. Dr. Macbride, in his very valuable and ingenious eſſays, has ſuggeſted another mode of adminiſtring Fixed Air. Wort, ripe fruits, or any kind of ſaccharine ſubſtance, received into the alimentary canal, ſoon paſs into a ſtate

(f) Praxis medica. lib. 9, cap. 7.

ſtate of fermentation: and during this proceſs, the Fixed Air is ſeparated and may anſwer many uſeful medicinal purpoſes.

Under this idea, Dr. Macbride has ſtrongly recommended *wort*, as a very efficacious remedy in the *ſea ſcurvy*.

VI. The ingenious Mr. Bewly, has proved by a ſeries of well imagined and deciſive experiments, that Fixed Air is an *Acid*; that alkalies may be ſaturated and perfectly neutraliſed by this acid; and that its having a weaker affinity with the alkali than any of the other acids, affords a powerful and commodious way of exhibiting Fixed Air. *(g)*

The alkaline ſalt previouſly diſſolved in water, may be eaſily ſaturated with Fixed Air in Dr. Nooth's apparatus; and

(g) See Mr. Bewly's letters in the appendix to the 2d vol. of Dr. Prieſtley's Experim. and Obſerv. on Air.

and I generally direct the patient to drink an ounce of this medicated water, containing one ſcruple of alkaline ſalt, a tea-ſpoonful of any ſpirituous water, and a little ſyrup; and to waſh it down with a large ſpoonful of lemon juice, made into lemonade with ſugar and water.

VII. Clyſters of Fixed Air have been recommended by Dr. Prieſtley in putrid fevers; and in conſequence of this hint, Mr. Hey of Leeds was happily inſtrumental in the recovery of a young gentleman from a dangerous fever of this kind, accompanied with a putrid *diarrhœa. (b)*

This practice has been adopted by Dr. Warren, of Taunton; and alſo by my ingenious friend Dr. Percival, who has been very benevolently attentive to the medical uſes of Fixed Air.

VIII. Fixed

(b) See Mr. Hey's letter to Dr. Prieſtley, appendix to vol. 1, page 292.

VIII. Fixed Air may alſo be externally applied, either by a proper apparatus determining it upon the diſeaſed parts, or by mixing it with the air of the chamber ſo as to be freely and conſtantly reſpired. *(i)*

Is it not probable that the carrot poultice, or any other ſweet vegetable ſubſtance, applied in this form, owe their efficacy to the detachment of the Fixed Air during the application of the poultice?

Such are ſome of the various methods in which Fixed Air may be adminiſtred as a medicine. To determine the different proportions of Fixed Air contained in chalk and the fixed and volatile alkalies, which are the ſubſtances moſt commonly directed for the ſupply of Fixed Air, I made the following experiments.

EXPERIMENT

(i) Dr. Rotheram's letter to Dr. Percival, Med. and Exp. Eſſays, vol. 3d.

EXPERIMENT I.

Two drams of powdered and well-dried chalk were put into a twenty-ounce vial, and to this were added three ounces of water: the vial, chalk, and water, weighed exactly nine ounces, ſix drams, and one ſcruple. As much acid of vitriol diluted with water was then added, as was ſufficient to ſeparate the whole of the Fixed Air of the chalk; which was effected by one ounce, one ſcruple, and twelve grains of the dilute acid. The vial, with it's contents, now weighed ten ounces, ſix drams, and ten grains. Two ſcruples therefore, and two grains of Fixed Air, had been ſeparated from this quantity of chalk by the addition of the acid.

EXPERIMENT II.

Two drams of dry and pure ſalt of tartar, managed as in the preceding experiment, yielded one ſcruple and eight

grains of Fixed Air. The reſult of this experiment correſponds with a ſimilar one made by the accurate and ingenious Profeſſor Black. *(k)*

EXPERIMENT III.

Two drams of volatile ſal ammoniac carefully treated as in the firſt experiment, gave two ſcruples and eight grains of Fixed Air.

It appears, therefore, from theſe experiments, that two drams of each of theſe ſubſtances contain the following proportions of Fixed Air.

VOLATILE SAL AMMONIAC,	48 grains.
CHALK, - - -	42 grains.
SALT OF TARTAR, - -	28 grains.

In the above experiments, ſome ſmall portion of water, or other heterogeneous matter, might riſe together with the

(k) Eſſays Phyſic. and Literary, vol. 2, p. 177.

the Fixed Air. To prevent this, however, a very tall vial was uſed, the acid added ſlowly, and the vial lightly cork'd during the efferveſcence.

SECTION II.

Of the ſenſible effects of Fixed Air in Health, taken internally.

Pyrmont and other mineral waters which are ſtrongly impregnated with Fixed Air, when drank in their full vigour as immediately drawn from the ſpring, have a very ſenſible effect on the brain and nervous ſyſtem; they raiſe the ſpirits, diffuſe an agreeable glow through the whole body, quicken the pulſe, and often excite a vertigo and temporary intoxication. To determine whether Fixed Air, as procured by art for medicinal uſes, had ſimilar effects, I made the following experiments.

EXPERIMENT I.

One ſcruple of ſalt of tartar diſſolved in a large ſpoonful of water with a little ſugar, and drank inſtantly on being mixed with half an ounce of lemon juice, had little ſenſible effect, except that it quickened the pulſe three or four ſtrokes in a minute for about ten minutes. Half a ſcruple of volatile ſal ammoniac, taken in the ſame manner, with half an ounce of lemon juice, had nearly the ſame effects.

EXPERIMENT II.

Two ſcruples and three grains of ſalt of tartar, a quantity which yields ten grains of Fixed Air, were diſſolved in half an ounce of water; to this was added rather more than an ounce of lemon juice, and inſtantly drank as the efferveſcence commenced. The natural ſtate of the pulſe, at this time, was 71. The effects of the mixture on the pulſe were

In 5 minutes	-	-	74
10	-	-	77
15	-	-	76
20	-	-	73
30	-	-	71

Immediately on drinking the mixture, there was an agreeable ſenſation in the ſtomach, with a ſlight glow and a ſlight degree of vertigo, which continued for about twelve minutes.

After the pulſe had returned to the natural ſtate, the ſame mixture was repeated, and with the following effects.

In 5 minutes	-	-	74
10	-	-	77
15	-	-	80
20	-	-	75
30	-	-	74
40	-	-	73
60	-	-	71

The vertigo was ſlighter, but continued longer; there was likewiſe a ſlight degree of nauſea, and the pulſe was ſomewhat ſmaller for 15 minutes, than after the former doſe. It acted as a diuretic; but this effect might proceed from the neutral ſalt of the mixture, as well as from the Fixed Air.

From theſe experiments we learn, that the Fixed Air of ſalt of tartar acts as a gentle ſtimulus on the ſtomach, extends its influence to the brain and nervous ſyſtem, and quickens the action of the heart and arteries. We likewiſe learn, that eight or ten grains of this kind of Fixed Air, is as large a doſe as can be exhibited, without producing a conſiderable degree of nauſea.

EXPERIMENT III.

One ſcruple and five grains of volatile ſal ammoniac, a quantity which gives ten grains of Fixed Air, drank with

with a full ounce of lemon juice, produced nearly the ſame effects with the Fixed Air of the ſalt of tartar in the preceding experiment; with this difference only, that inſtead of the glow, it excited an agreeable ſenſe of coolneſs in the ſtomach.

SECTION III.

Of the effects of FIXED AIR in diſeaſes of the putrid claſs.

§ 1. PUTRID FEVERS.

Putrid fevers rarely acquire any great degree of malignancy in Liverpool, or it's neighbourhood; and when they do appear, it is generally among the lower ranks of people. A fever of this kind crept into our public hoſpital in the ſpring of the year 1773, and a conſiderable number were infected.

The following caſes are tranſcribed from the notes, which were taken during

during my attendance on the reſpective patients.

CASE I. *(l)*

Mary Rainford, about 15 years of age, was admitted into the hoſpital on account of convulſions; ſhe was ſubject likewiſe every three or four weeks to vomit large quantities of blood, and was much enfeebled by theſe complaints at the time of her being ſeized with the fever.

She firſt complained of pain and weight in the head, pain in the limbs and back, and a great degree of langour and dejection; ſhe had frequent chills alternating with fluſhes of heat, and got very little reſt. The *tartar emetic* was given, and operated eaſily and powerfully by vomit; a bliſter was applied between the ſhoulders; and an ounce

(l) The three ſubſequent Caſes were publiſhed in the Appendix to the 2d vol. of Dr. Prieſtley's Exper. and Obſerv.

ounce of *ſpiritus mindereri*, made agreeable to the palate with a little ſugar and compound ſpirit of lavender, was ordered to be taken every three hours.

She had for common drink, lemonade with ſweet mountain, or barley-water well acidulated; the body was kept ſoluble either by clyſters, or ſome gentle purgative, and the room was well aired by opening the door and windows. But notwithſtanding the ſteady uſe of theſe means, the fever became more and more untoward, and was on the ſixth day accompanied with ſuch dangerous ſymptoms, as made it neceſſary to adopt ſome other method. The eyes were heavy, the *conjunctiva* red, large *petechiæ* ſpread over different parts of the body, the tongue was covered with a brown fur, and the teeth with a fur of a blackiſh colour; ſhe was very feeble, got no ſleep, and was frequently delirious, eſpecially during

the night. Hitherto the ſtate of the pulſe had been about 120, now it was 135, and very weak.

One ſcruple of ſalt of tartar and one ſcruple of ſugar diſſolved in half an ounce of water, and half an ounce of lemon juice, were given every hour in the ſtate of efferveſcence. The patient took no other medicine, the ſymptoms became more favourable, and ſhe was out of danger in four days.

CASE II.

Alice Rigby was received into the hoſpital for a ſore leg, and during her ſtay was attacked with the fever of the houſe. The progreſs and treatment of the diſeaſe for the firſt week, were nearly the ſame as in the preceding caſe. On the ſeventh day ſhe was extremely weak, got no reſt; there were large *petechiæ* on many parts of the body, the brain was much

much affected, pulſe 125, and the tongue little differing from the natural ſtate.

Fixed Air was now adminiſtred in the ſame manner as to the former patient. The *petechiæ* ſoon began to diſappear, ſhe got ſtrength, the pulſe became fuller and ſlower, and the fever was in ſix days entirely removed. The bark was at this time ordered, as an additional ſecurity againſt a relapſe.

CASE III.

March 20. A conſultation was deſir'd for Ann Knowles, who had been in the hoſpital for a conſiderable time, and was much reduced by a long continued rheumatiſm at the time ſhe was attacked with the fever. This was the ſeventh day of the diſeaſe; and though ſhe had been very judiciouſly treated by the gentleman under whoſe care ſhe had been at firſt admitted, the fever grew

daily worſe, and was now accompanied with many dangerous ſymptoms.

I obſerved an extreme languor and dejection; the eyes heavy, the eye-lids half cloſed, and the *conjunctiva* inflamed. There was a ſtupor, with a muttering kind of delirium, and a continual toſſing and moaning. The pulſe very weak and very frequent, more than 140 in a minute; the tongue moiſt and clear, and not altered from it's natural appearance, except that it was of a deep red. The whole body was covered with ſmall *petechiæ*; ſhe had frequent ſtools, which were extremely offenſive, and her little remains of ſtrength were every hour ſtill more and more exhauſted.

It was agreed that ſhe ſhould take the Fixed Air in the ſame way I had ordered it for the two preceding patients.

March 21. The good effects of this medicine

medicine were evident, though the ſymptoms were ſtill urgent and alarming: the ſtools leſs frequent, but offenſive; the pulſe 130, and not ſo languid: in other reſpects the patient was not much altered.

23. The *petechiæ* diſappearing, the looſeneſs diminiſhed, and the ſtools much leſs offenſive; pulſe 110; ſleeps and gets ſtrength. The medicine was now to be given only every four hours.

24. Stronger and better, pulſe 100, head much clearer, and the tongue has more of it's natural red.

26. Pulſe 85; and from this time the fever entirely left her. She took no other medicine, and had no relapſe.

I have directed Fixed Air, both in hoſpital and private practice, for a variety of patients, in fevers attended with

with ſymptoms of putrefaction, and with ſucceſs. It would be ſuperfluous to enter into a numerous detail of particular hiſtories; I ſhall only therefore relate one inſtance more of the happy effects of Fixed Air in putrid fevers, and in which the fever was accompanied with a very alarming putrid *diarrhœa*.

CASE IV.

December 1772, Mr. Birdſall, of Ormond-ſtreet, Liverpool, on the nineteenth day of a fever, to which there had been an imperfect criſis on the fourteenth, began to be reſtleſs, and complained of great pains in the bowels, which were ſoon accompanied with frequent looſe ſtools of a greyiſh black colour, extremely offenſive, and joined with an almoſt conſtant *teneſmus*. Theſe painful evacuations continued to be very frequent for 30 hours, but without diminiſhing the fever or giving the leaſt

leaſt relief to the patient; on the contrary, the ſtrength was much exhauſted, and the heat, thirſt, and frequency of the pulſe much increaſed; there was an inexpreſſible languor, reſtleſſneſs and anxiety, and the danger was great and immediate.

In this very urgent ſituation, it was neceſſary as expeditiouſly as poſſible to correct the putrid ferment, check the evacuations, and relieve the conſtant and painful *teneſmus*.

One ſcruple of ſalt of tartar, and the ſame quantity of ſugar diſſolved in half an ounce of water, and half an ounce of lemon juice, were given every hour in the ſtate of efferveſcence. After four doſes, the pains were much abated, the putrid ferment corrected, and the evacuations leſs frequent and leſs offenſive.

The medicine was now given every third

third hour; and in thirty hours, this train of alarming ſymptoms was at an end; and the patient recovered without any further difficulty.

In caſes ſimilar to this, ſhould the *teneſmus* remain after the putrid ferment is corrected, an opiate reſtringent clyſter might be adminiſtred with ſafety and advantage.

It appears from the preceding hiſtories, that Fixed Air is a powerful antiſeptic; that it is a medicine of conſiderable efficacy in putrid fevers; and that by correcting acrimony, it raiſes the pulſe and diminiſhes the frequency. It likewiſe appears from the laſt caſe, that in fevers accompanied with a putrid *diarrhœa*, Fixed Air, as obtained from ſalt of tartar by giving it with lemon juice in a ſtate of effervescence, is equally efficacious, and may be more eaſily and expeditiouſly adminiſtred than by clyſter.

§ 2. *Small-pox and Meaſles attended with ſymptoms of malignancy.*

The ſecondary fever in the ſmall-pox is often accompanied with dangerous ſymptoms of the putrid kind, and is a ſource of great mortality in this very fatal diſeaſe. The learned Dr. Freind recommends the free uſe of purgatives as ſoon as the puſtules begin to croſt, and during the continuance of the fever. *(m)* I have often experienced the good effects of this judicious practice; and have generally alſo at the ſame time, given wine liberally, both as an antiſeptic, and as particularly uſeful in ſupporting the ſtrength of the patient, during the copious evacuations produced by the purgatives.

I have likewiſe found Fixed Air a medicine of ſingular efficacy in this ſtage of the ſmall-pox; and have ſe-

(m) Johannes Freind *de purgantibus* in ſecunda variolarum confluentium febre, &c.

lected the following hiſtory from a number of others, in which Fixed Air was given with advantage.

CASE V.

Ann Forbes, ſervant to Mr. Hume, of York-ſtreet, Liverpool, had the *confluent ſmall-pox* in Auguſt 1773. The weather was extremely hot, and the ſymptoms ſo very unfavourable, that there did not appear the moſt diſtant hope of her recovery. Particular care was taken to have a conſtant ſupply of freſh air, and the antiphlogiſtic treatment was ſtrictly purſued during the inflammatory fever. The diſeaſe was now advancing into the putrid ſtage, and the ſecond fever commenced with little or no appearance of ſuppuration.

Notwithſtanding every precaution with reſpect to the free acceſs of air, change of linen, and every circumſtance of cleanlineſs, the unlimited uſe of oranges, lemonade

lemonade and wine negus, this poor creature was the moſt miſerable object I ever beheld. She became extremely offenſive, and had the appearance of one continued maſs of *putrid ichor*; the pulſe ſmall and rapid, and ſhe had a conſtant reſtleſſneſs with inexpreſſible anxiety.

A purgative was directed, and a glaſs of ſweet mountain after every ſtool. The ſymptoms however became more alarming, the offenſiveneſs was almoſt intolerable, and ſhe was frequently ſick, agitated, trembling, and like one about to expire. In this urgent ſituation, I determined to try the effects of Fixed Air, and it was given in the manner already mentioned.

The nurſe and attendants ſoon obſerved an agreeable change. In 24 hours the putrid ſtench was much diminiſhed, the breath of the patient was not near

offenſive, and the chamber was very tolerable compared with what it had hitherto been. In two days more ſhe was ſtill much better; and by repeating the purgative, giving wine occaſionally, and perſevering in the uſe of Fixed Air, her recovery was ſurpriſingly ſpeedy and perfect.

When the patient has been ſo young as to render it impracticable to give the ſalt of tartar and lemon juice, I have directed the naked body to be held over an efferveſing mixture, or a ſtream of Fixed Air to be applied ſucceſſively to different parts of the body, and by the uſe of theſe means, have found the putrid ſymptoms powerfully corrected.

For the two following caſes, I am indebted to my ingenious friend Dr. Haygarth, of Cheſter, an accurate and judicious obſerver both of the nature of

of diſeaſes, and of the effects of medicines.

CASE VI.

On March 21, 1776, at ten in the morning, I was deſired to viſit Maſter Davies, a year and a half old, in the ſmall-pox. It was the 6th day of the fever, and 4th of the eruption; the puſtules were numerous, but diſtinct: he had a looſeneſs, but no alarming ſymptom, except two large black puſtules on his loins. The next morning there were ten, that evening twenty, and the following morning, which was the 8th, I reckoned thirty black puſtules, of different ſizes, on his hips and loins.

On my firſt ſeeing the patient, I ordered him to take every three hours, an ounce of an *aqua mephitica alkalina*, which contained a ſcruple of ſalt of tartar, ſuperſaturated with Fixed Air,

and

and ſufficiently ſweetended; and immediately after this, half an ounce of lemon juice made palatable with ſyrup of oranges. He was alſo directed to drink plentifully of malt tea. After the 8th day, when theſe medicines had been taken 36 hours, no more black ſpots appeared, tho' the medicine was then omitted from the neglect of the nurſe.

On the 16th day, when the ſmall-pox were falling off, twenty of the above-mentioned black puſtules were converted into as many ulcers of various ſizes on his hips and loins. In ſeven of theſe, round columns of black mortified fleſh ſtill remained; the largeſt of which were half an inch in perpendicular depth, and about three-fourths of an inch in circumference at top, and broader at bottom. They were ſeparated on all ſides from the cylindrical ulcers which contained them, ſome

of

of which appeared to be two inches in circumference.

I now ordered the alkaline ſalt in the proportion above deſcribed, to be diſſolved in a cold infuſion of peruvian bark inſtead of water, and which was made not unpalatable by the Fixed Air and ſyrup. An ounce was taken punctually every four hours, and a proportional quantity of the lemon juice julep was drank immediately after it. All the mortified ſloughs ſoon ſeparated, and the ulcers ſoon healed.

CASE VII.

Maſter R. M. two years old, after an indiſpoſition of two months, denoted by want of appetite, reſtleſs, hot nights, wan complexion, and ſunk eyes, was ſeized with ſneezing, a cough, a fever, and an eruption which appeared to be the meaſles. During this illneſs, he was vomited at three different times with emetic

emetic tartar, and always with manifeſt advantage in relieving his breath, cough, and fever; he took two gentle purges during the eruption, and two after; but was never bled.

On May 22, 1776, ſix days after the eruption diſappeared, there came on his legs, thighs, hips, back and arms, a great number of broad livid ſpots under the ſkin, ſome of them as large as the palm of the hand. Four days before, innumerable ſmall purple ſpots, like old flea-bites, were ſeen on all parts of his body. A ſmall ulcer had been obſerved ſome time in one corner of his mouth, which became gradually worſe, and now (May 22) appeared like a large black mortified ſlough, ſurrounded with a conſiderable ſwelling of the lips, and adjoining cheek; the lips bled frequently. On this day, a large black ſpot appeared on the chin, which ſpouted out blood from various

points;

points; and became a black ſcab, three or more inches in circumference. He had alſo the chincough.

In theſe circumſtances, gr. iv. of fixed alkali, ſuperſaturated with Fixed Air, were taken in half an ounce of water every two or three hours, and a draught of lemonade after each doſe. Three days after, gr. vi. of alkali were given every two hours. Theſe orders were executed ſo punctually, that 240 grains or half an ounce of the alkaline ſalt had been taken in ſix days. At which time, May 28, both the livid and purple ſpots had nearly vaniſhed; the lips were greatly advanced in a healing ſtate; the chin had a dry ſcab, which dropped off two days after, and left nearly a whole ſkin; neither his lips nor chin had bled for two days. His appetite was good, except during ſome feveriſh acceſſions which returned irregularly. In every other reſpect he gra-

dually recovered, except the chincough, which daily increaſed; but this diſeaſe alſo ceaſed in a few weeks.

The Dr. ſuggeſts, from this caſe, as far as a ſingle caſe can give inſtruction, that Fixed Air might probably be an uſeful remedy in the epidemical putrid meaſles, a diſtemper lately deſcribed in a maſterly manner by his learned friend Dr. Watſon, in the London Medical Inquiries.

The following is an extract alſo from one of Dr. Haygarth's letters, written in December, 1777.---" I think myſelf much obliged to you, for ſuggeſting the uſe of Fixed Air as an antiſeptic in the ſmall pox. To a patient in a bad confluent kind, I ordered the alkaline and acid juleps; and the child's mother, who was not told what effect the medicine was intended to have, preſently remarked that it had made the breath

breath much ſweeter. I cannot ſo far flatter myſelf as to think that it will prevent the ſecond fever; but I aſſure you, much beyond my hopes, this patient had ſcarcely any ſigns of it. On the 11th, 12th, and 14th days of the diſeaſe, her pulſe beat no more, when I reckoned them, than from 72 to 80, tho' ſhe is only five years old. She afterwards was hot occaſionally for a ſhort time; and on the 16th, her pulſe was 100, which was the moſt frequent I ever felt it, during this ſtage of the diſeaſe."

Extract of a letter from Mr. Sandbach to Dr. Haygarth.

"The ſmall-pox patient you attended (viz. Maſter D-----) was in a truly alarming ſituation. You may remember a number of the puſtules on the breech became gangrenous and formed pretty deep eſchars, the diſcharge from which was very conſiderable and very

offenſive, the child extremely feveriſh and much emaciated.

" In two days after taking the infuſ. per. alkalin. meph. and acid julep, the feveriſh ſymptoms abated, the diſcharge was ſomewhat diminiſhed, the gangrenes put on a more favourable aſpect, and the eſchars ſoon after ſeparated.

" The extraordinary good effects of this medicine in the above caſe, induced me to make trial of it in the following one:

CASE VIII.

" Sept. 5th, 1777, I was called to a young man (19 years of age) labouring under the confluent ſmall-pox. It was the 11th day of the diſeaſe from the eruption, he had taken no medicines except what had been adminiſter'd by an old nurſe, under whoſe management he had been the whole of his illneſs.

neſs. She had, I believe, kept him very warm, and ſhut out as much as poſſible all communication of external air, that of the room was exceeding offenſive; the patient's face was covered almoſt entirely with a dark-coloured ſcab, petechiæ were obſervable on many parts of the body of a livid hue, a number of the puſtules on the arms, legs and body, had run together and formed large bladders, ſome the ſize of a crown piece, fill'd with a dark-coloured ſerum; the pulſe was extremely quick and ſmall, the tongue dry and black, great reſtleſsneſs, ſubſultus tendinum, with ſome degree of delirium. Under theſe circumſtances I had little to expect from medicines of any kind; I however ordered him the infuſ. per. alk. meph. and acid julep.

" Sept. 6. Fever much abated, patient leſs delirious, ſeveral of the bladders had burſt during the night; every ſymptom

tom more favourable.---From this time he grew daily better; he continued the uſe of the medicines till the 19th inſt. without any complaint intervening, except a tickling cough, which ſoon left him; he remain'd in a feeble ſtate ſome time.

" I have frequently given the above medicine in ill-conditioned ulcers and abſceſſes happening after the ſmall-pox, with great advantage, where there has been every reaſon to dread an approaching hectic."

§. III. GANGRENE.

In the three laſt caſes which have been related, and in which there was a ſtrong gangrenous diſpoſition, Fixed Air was given with evident good effect: and my friend Dr. Percival has favour'd me with the following hiſtory of a *mortification of the leg*, in which Fixed Air was

was adminiſtred, after other powerful medicines had been tried in vain.

CASE IX.

Mr. O---, aged about 60 years, of a groſs habit and with a ſhort neck, had been long ſubject to an humoral aſthma. His difficulty of breathing having increaſed very much, I was called to his aſſiſtance April 6, 1777. From his bloated countenance, oppreſſed pulſe, great breathleſsneſs, diminiſhed ſecretion of urine, and from a ſlight ſwelling of his legs, I immediately apprehended that he laboured under an *anaſarca* of the lungs. A bliſter between the ſhoulders had been applied by Mr. Henry his apothecary, who had likewiſe adminiſtred ſeveral active remedies.

Purgatives, expectorants, and diuretics were tried till April 18, but without any apparent good effect. The patient's

patient's countenance was now livid, his pulſe ſcarcely perceptible; his breathing very laborious; and he was generally aſleep, unleſs rouſed by his attendants. Orders were given to apply bliſters to each leg; and to take every four hours a draught, the chief ingredients of which were oxymel of ſquills, dulcified ſpirit of nitre, and compound juniper water.

April 19. The bliſters had diſcharged an extraordinary quantity of *ſerum*, and the patient had voided ſeveral pints of urine. His breathing was now tolerably eaſy; his expectoration copious; the drowſineſs had left him; and he had almoſt recovered his natural countenance and complexion. Theſe favourable ſymptoms continued till the 27th, when a violent *Eryſipelatous* inflammation came on both his legs, and the ſucceeding day a *mortification* appeared, and ſpread rapidly on the outſide of one

one of them, oppoſite to the part which had been bliſtered. I was at this time abſent from Mancheſter; and Mr. White was called to the aſſiſtance of my patient. He ſcarified the leg, applied the uſual dreſſings to it, and directed the common fomentation, with camphorated ſpirit of wine; and a ſaline draught, with tincture of bark, to be taken every three hours.

April 30. I found the patient in the circumſtances above deſcribed, with a quick and hard pulſe, dry ſkin, and other ſymptoms of fever. The mortification was enlarging itſelf every way, and the lividneſs extended to the middle of the thigh. V. S. was directed; and a ſcruple of nitre, with 15 grains of cicuta, were given every four or five hours.

May 1. Every appearance was more unfavourable; and the caſe of our pa-

tient ſeemed, both to Mr. White and to myſelf, to be deſperate. I ſuggeſted the trial of Fixed Air; and preſcribed half a dram of ſalt of wormwood, with a ſufficient quantity of the juice of lemons, to be taken in the ſtate of effervescence every two hours; hoping that this remedy might act as an antiſeptic, febrifuge, and diuretic. The patient was alſo deſired to drink freely of *ſeltzer-water*.

May 2. The fever was abated, the progreſs of the mortification checked, and the putrid ſtench corrected.

May 3. The ſores began to diſcharge good matter; ſenſibility was reſtored to the whole leg and thigh; freſh granulations ſucceeded; and the parts from this time healed ſlowly and kindly. The internal uſe of Fixed Air was continued about a fortnight.

Mr.

Mr. Power, of Poleſworth, ſucceſsfully treated two caſes of mortification with fermenting cataplaſms. Flower, honey, and water, were mixed into a paſte, ſet by the fire till they began to ferment, and then applied to the parts affected. *(o)*

§ 4. *Ulcerous ſore-throat.*

The ulcerous ſore-throat occurs more frequently, but appears to be leſs malignant than it was about the middle of the preſent century, when Dr. Fothergill publiſhed his excellent obſervations on this diſeaſe. The fever however is ſometimes ſtill malignant, and the ulcerated parts diſpoſed to degenerate into the gangrenous ſtate. When this is the caſe, the moſt powerful antiſeptics are indicated, and tho' aſſiduouſly adminiſtred both internally and externally, they are too often inſufficient to check the progreſs of the diſeaſe.

(o) Medical Tranſactions, vol. III.

Mr. White, in his valuable *Treatiſe on the Management of Pregnant and Lying-in Women*, obſerves, that much advantage has been derived from fumigating the ulcers with Fixed Air: *(p)* and Mr. Henry removed a very large and deep ſlough in the putrid ſore throat, and healed the ulcer more expeditiouſly by the inſpiration of Fixed Air, than by any other method. *(q)* I have likewiſe experienced the ſame good effects from Fixed Air, as detached in the efferveſcing draughts made with ſalt of tartar and lemon juice, and repeating the doſe every two or three hours. Fixed Air, thus adminiſtred, acts both as a topical and general remedy; it checks the putrid fever, and brings the ulcerated parts into a benign and healing condition.

I have

(p) p. 182, ſecond edition.

(q) See Mr. Henry's ingenious Experiments and Obſervations, &c. p. 127.

I have juſt received the following intelligence on this ſubject from Dr. Haygarth. " In a late inſtance, the reſpiring of Fixed Air, detached from chalk by the vitriolic acid, ſeemed remarkably efficacious in removing and in preventing the regeneration of a *black ſordes*, that had covered the fauces, roof of the mouth, tongue and teeth, in a fever that had many other ſymptoms which denoted an uncommon degree of putrefaction. This putrid fever had been preceded by an ulcerous ſore throat, and a violent Phrenitis. In two other putrid fevers that have ſince occurred, the reſpiration of Fixed Air appeared very beneficial in removing this *black ſordes* from the mouth."

The ſame Phyſician ſent me the following.

CASE X.

" I had lately a patient, on whom Fixed Air ſeemed to have a remarkably good

good effect. A boy five years old, three weeks before I ſaw him, had been attacked by an ulcerous ſore-throat, and ſcarlet fever, during which I believe he had taken few or no antiſeptic remedies. I was conſulted for various ailments which were the conſequence of theſe diſeaſes, and appeared to proceed from a *diſſolved ſtate of the blood.* During the fortnight before I ſaw him, he had frequent hæmorrhages from the noſe. His urine was in ſufficient quantity, and yet contained a ſediment which was in bulk equal to a third part of the whole. The urine while warm was very red, and the ſediment, on dropping, was of a dark brown or rather black colour. Theſe circumſtances denoted that it contained a conſiderable admixture of blood. He had large, frequent, liquid ſtools. There was a copious ſerous effuſion into moſt of the cavities of the body; his belly was increaſed four or five inches in circumference,

and

and a fluctation was perceivable on percuſſion; he had great difficulty in breathing, which was remarkably increaſed on the leaſt motion, when falling aſleep he was frequently rouſed with a ſenſe of immediate ſuffocation; he was anaſarcous from head to foot.

" Various remedies were uſed to obviate different ſymptoms, as, bliſters for his difficulty of breathing; ipecacuanha and rhubarb for his *diarrhœa*; and diuretics for his dropſical ſymptoms, as, cryſtals of tartar, ſpirit of nitre, and friction of the abdomen with olive oil and ſpirit of turpentine. But Fixed Air appeared to be the remedy the moſt efficacious in reſtoring his health; which he recovered almoſt perfectly in a week after he began to take it. The *alkaline* and *acid* juleps were adminiſtred pretty regularly; and I attribute much good effect to the following method of exhibiting wort in a *fermenting*

menting ſtate. Leſs than an equal bulk of wort was drawn from the malt, namely, from ſix pints of malt, about five pints of wort. With a pint of this wort, a tea-ſpoonful of yeſt was well mixed, the veſſel was covered cloſe, and placed near the fire. In leſs than an hour it began to ferment, and was drank in that ſtate. This patient took about a pint every 24 hours. I am perſuaded that the wort is greatly improved by this proceſs. Yeſt excites in the wort a vinous fermentation and copious generation of Fixed Air; without ſuch addition, its ſpontaneous change is into an acetous ſtate, by which very little Fixed Air is evolved."

§ 5. *Pulmonary Conſumption.*

Dr. Percival has tried Fixed Air in more than thirty caſes of *Phthiſis Pulmonalis.* The hectic fever was in ſeveral inſtances abated, and the matter expectorated became leſs offenſive and better digeſted:

digeſted: he ingenuouſly confeſſes however, that he has not been ſo fortunate as to cure one ſingle patient by this remedy. *(r)* Dr. Withering informs Dr. Percival, that he has been more ſucceſsful; that one phthiſical patient was entirely recovered by inſpiring Fixed Air; that another was rendered much better; and that a third, whoſe caſe was truly deplorable, ſeemed to be kept alive by it for more than two months. *(ſ)*

Dr. Hulme has likewiſe given this remedy in hectic fevers, attended with pulmonary complaints, and he thinks with ſucceſs. *(t)*

With reſpect to my own experience of the effects of Fixed Air in pulmonary conſumptions, I have never met

(r) Eſſays Medic. and Exp. vol. 2, p. 72.
(ſ) Ibid. p. 73.
(t) A ſafe and eaſy remedy, &c. p. 17.

with one inſtance, in which the patient recovered by the uſe of this remedy, when the diſeaſe originated from tubercles. But in caſes of abſceſs in the lungs, whether from peripneumony or accidental injury, I have ſeen very ſalutary effects from Fixed Air.

CASE XI.

Fuller Turkey, about forty years of age, was made an out-patient of the hoſpital, November 25th, 1773. He was a ſailor, and had been cruelly treated nine or ten months before, when out at ſea. He was thrown down, and received ſuch violent blows, when in this ſituation, that ſeveral of the ribs on the right ſide were broken, and the lungs much injured. The conſequence of which was, that he had great pain in the ſide, a very painful cough, and ſpit blood frequently, and in large quantities. When I firſt ſaw him, the *bæmoptoe* had ceaſed, but the cough and

and pain were worſe, the reſpiration very difficult, the breath very offenſive, with a copious expectoration of purulent matter, night ſweats, and the pulſe from 120 to 130.

Bleeding in ſmall quantities, emetics, anodynes, demulcents, had not the leaſt power to check the progreſs of the diſeaſe; ſo that by December the fourth he was become extremely weak, and not able to quit his bed; the reſpiration ſtill more difficult and ſuffocating, the breath ſo offenſive as to taint the whole room, and the pulſe ſtill more frequent.

He was now directed to receive into the lungs, the Fixed Air of chalk detached by the acid of vitriol, and to take the ſalt of tartar and lemon juice in the ſtate of efferveſcence three times a day. In ſeven days, the cough was more moderate, the reſpiration eaſier, the

the ſpitting, hectic, and night-ſweats diminiſhed, and the breath not at all offenſive. In four weeks more, he had gotten ſtrength and fleſh, and was free from his pulmonic affections.

CASE XII.

About the ſame time with the above patient, a young gentleman was under my care, on account of an abſceſs in the right lobe of the lungs. There were repeated collections of matter, and repeated ruptures, with great diſcharges of blood as well as pus. The breath was intolerably offenſive, the cough very painful and troubleſome, with hectic and ſweats.

This patient recovered, and received evident benefit from the effverveſcing draughts, and the inſpiration of Fixed Air.

§ 6. SEA SCURVY.

The ſcurvy, properly ſo called, is a diſeaſe which in this climate, rarely occurs on land, eſpecially to thoſe who live on freſh vegetables and ſound animal food. I have met, however, with ſome caſes of the true ſcurvy, to which none of the uſual and known cauſes of this diſeaſe appeared to have contributed. In the Summer of the year 1776, I was conſulted for a young lady who had the following complaints; purple ſpots on the arms and legs, cramps and pains in the limbs, pulſe ſmall but not frequent, oppreſſion on the breaſt, debility, fœtid breath, with ſoft and ſpungy gums, from which there were conſiderable hemorrhages. This patient drank water ſaturated with Fixed Air, took the effervеſcing draughts, and was allowed to eat ripe fruit at pleaſure; ſhe was perfectly recovered in the courſe of three weeks. Many ſeamen, afflicted with the ſcurvy, on coming into port have

have been under my care, and have been cured by the efferveſcing draughts, or by proper doſes of Mr. Bewly's mephitic julep waſhed down with lemonade.

Dr. Macbride, who has been very laudably attentive to the means of checking the ravages of the ſcurvy during long voyages, recommended ſome years ago the uſe of *wort* or *infuſion of malt*. "Every kind of recent vegetable, ſays the Doctor, that can be taken in the way of diet, will cure the ſcurvy; *wort*, or *infuſion of malt*, is ſimilar in it's qualities to the freſh juices of many of theſe, and therefore ought to produce ſimilar effects: let this infuſion be ſubſtituted for the freſh juices, and obſerve whether it cures the ſcurvy; for if it does, then a remedy for this diſeaſe need never be wanting; becauſe malt, when well dried, will remain ſound for years, may be carried to ſea, and always

kept

kept in readineſs, in caſe the ſcurvy ſhould break out among the crew." *(u)*

It was difficult to get ſuch trials of the *wort* to be made, as were neceſſary to confirm the truth of this ingenious theory, and anſwer the benevolent expectations of its author. This however appears at laſt to be accompliſhed. Dr. Macbride has favoured me with the following account of the preſent ſtate of his evidence, with reſpect to the efficacy of the *wort*.

" The firſt account that I had of the wort's having been tried at ſea, was from the ſurgeon of His Majeſty's ſhip Jaſon, in April 1772; and the ſecond was received in a few months afterwards, from the Surgeon of the Nottingham Eaſt-Indiaman. Both of theſe, I preſume, you muſt have ſeen, as I publiſhed

(u) Appendix to Dr. Macbride's Methodical Introduction to the Theory and Practice of Phyſic, p. 639.

publiſhed the Caſes, which were ten in number, ſoon after they came into my hands, in a ſmall pamphlet, under the title of *an hiſtorical account of a new method of treating the ſcurvy at ſea*; and again, in 1772, as an appendix to a book, which I called *a methodical introduction to the theory and practice of phyſic*.

" I did imagine that theſe Caſes (ſix of which are ſufficiently concluſive in favour of the wort) would have gone near to eſtabliſh the credit of the malt infuſion as an antiſcorbutic; but my expectations, it ſeems, were rathar too ſanguine, ſince I find they did not ſerve to convince the perſon whom of all others I could have wiſhed to be convinced, namely, Dr. Lind; who ſtill continues to pronounce, " that it is not probable a remedy for the ſcurvy will ever be diſcovered from a preconceived hypotheſis, or by ſpeculative men in the cloſet." And he complains, more-

over,

over, " of the miſchief done by an attachment to deluſive theories." *See the preface to the third edition of his Treatiſe on the Scurvy.*

" In the ſame appendix, you have ſome little account of the ſucceſs of the wort on board the Queen Eaſt-Indiaman; as alſo a ſhort abſtract of the journals, delivered in at the Admiralty Office, by the ſurgeons of the Dolphin, Swallow, and Endeavour; together with a remarkable hiſtory communicated by Dr. Fothergill, wherein the efficacy of the wort was very conſpicuous.

" Since the time of the laſt-mentioned publication, I have received the journal of Mr. Skiddy, ſurgeon of the Intrepid man of war, on a voyage to India, in 1772; and that of Mr. Patten, ſurgeon of the Reſolution, during her late voyage to the ſouthern hemiſphere, of which we have the two-fold hiſtory, by Capt. Cooke and Mr. Forſter.

" Mr. Skiddy gives a very diſtinct account of about twenty ſcorbutic patients, though he ſays there was more than double that number on his ſick liſt. It appears that the ſhip was but ſcantily provided with water, and for that reaſon he could not afford more than two quarts in the day of the infuſion, to ſuch of the ſick as ſtood moſt in need of it, and three pints to thoſe whoſe diſtreſſes were leſs urgent. Only two patients of the whole number could be ſaid to recover, while the ſhip continued at ſea, but all of them were kept alive, and in moſt, the progreſs of the diſeaſe appears to have been retarded; inſomuch, that when the ſick were landed at Madagaſcar, they every man recovered, in a very ſhort time. Mr. Skiddy mentions his ſurprize, on finding that few of his patients who took the wort, were purged by it; but he accounts for this circumſtance, from their being ſuffered to live too much on

flour

flour and water boiled up together, and to eat too freely of a crude kind of paſtry, which the ſailors call dough-boys (or dumplings) and pandowdles, which are cakes made of only flour and water, and fried in beef fat.

" This regimen, no doubt, would counteract the laxative quality of the wort, and conſequently render it leſs efficacious.

" With reſpect to the ſucceſs of the wort on board the Reſolution, the public is already pretty well informed, from the two hiſtories of the voyages already mentioned, and from Sir John Pringle's diſcourſe annexed to Capt. Cooke's account. But the ſurgeon's journal, in my poſſeſſion, is ſtill more explicit and ſatisfactory; for whereas Captain Cooke makes a doubt whether the wort will cure the ſcurvy in an advanced ſtate, at ſea; the caſes in Mr. Patten's journal

demonſtrate, that it will; and he expreſſes his opinion, that the wort (if the malt be ſound, and the infuſion properly prepared,) will ſeldom fail to accompliſh a cure, even though the ſhip ſhould happen to be kept out at ſea; and he thinks that when it has failed, the diſappointment has been owing, either to the unſoundneſs of the malt, inattention with reſpect to preparing the infuſion, or not adminiſtring it in ſufficient quantity. There will, no doubt, however, ſometimes occur ſuch an untoward combination of ſevere weather, ſcarcity of water, bad proviſions, and a crowded ſhip, that even the moſt approved antiſcorbutics, if they were to be had, muſt fall ſhort of their uſual effects; as ſeems to have been the caſe on board the Swallow, in her paſſage acroſs the Pacific ocean; and in the Talbot Eaſt-Indiaman, according to Mr. Clarke's account, in his book

entitled,

entitled, *obſervations on the diſeaſes, in long voyages, to hot climates.*" (x)

The following caſe was communicated to Dr. Haygarth by Mr. Dawſon, of Sedbergh, Yorkſhire, whom the Doctor repreſents as diſtinguiſhed for his knowledge in medicine, and other branches of natural philoſophy.

CASE XII.

" Laſt September I was called to a boy, about 14 years of age, who had a violent hemorrhage from his noſe. When I ſaw him the bleeding was over, but it had been ſo profuſe, that his ſtrength was very much reduced. He was covered all over with purple or livid ſpots, many of them the breadth

(x) Extract of a letter from Dr. Macbride to the author.

While it was in the preſs, I heard, with deep concern, that he was no more. The loſs of a Phyſician of learning, integrity, and humanity, with a happy genius for inquiry and obſervation, in the prime of *medical life* and devoted to the duties of his profeſſion, is a misfortune to his friends, to the faculty, and to mankind. Such was my truly amiable and ingenious friend Dr. Macbride!

of

of a ſilver threepence; his fingers and toes did not eſcape. Upon his breaſt, one half at leaſt, was covered with them. His breath was extremely offenſive, his breathing laborious, and his gums were ſo ſpungy, that the ſlighteſt touch made them bleed. His pulſe between 130 and 140. Theſe ſymptoms preſented themſelves immediately upon inſpecting him. Upon inquiry of his nurſe, ſhe informed me, that his ſtools were very black and fœtid; and ſhe ſhewed me his water, which depoſited an inky ſediment.

" I ordered him to be kept in a half-ſitting poſture in bed, ſlightly covered, the windows and door open. The acid elixir of vitriol and bark were attempted to be given, but he could not be prevailed upon to take them. I therefore gave him 12 or 15 grains of ſalt of tartar, diſſolved in water, and ſaturated with the mephitic acid; and immediately after,

after, ſuch a quantity of lemon juice, diluted with water, and made pleaſant with ſugar, as would ſaturate the ſalt. This doſe was repeated every two, three, or four hours.

" I likewiſe attempted to make uſe of Fixed Air, in the manner recommended by Dr. Rotherham, but his breathing was ſo difficult he could not bear it. However, a mixture of chalk and water, into which oil of vitriol was poured, was frequently carried into the room where he lay.

" No other means but thoſe abovementioned, together with an antiſeptic diet, were made uſe of; and they had the deſired effect, for he grew every day a little better, till his health was perfectly recovered in ſeven or eight weeks time."

In a ſubſequent letter he writes, " I have

have had a putrid caſe lately, ſimilar to that I ſent you, which I treated in the ſame manner, and with the ſame ſucceſs. It was a child between four and five years old, who would take neither bark nor the mineral acids, but there was no difficulty in adminiſtring *any* quantity of Fixed Air."

Dr. Hulme recommends the following method of adminiſtring Fixed Air, for the cure of the ſcurvy at ſea:

" Take of pure ſalt of tartar one ounce, (troy weight,) diſſolve it in ſixteen ounces of common water; and call it the *alkaline mixture*. Alſo, take of weak ſpirit of vitriol two ounces, (in meaſure,) of common water fourteen ounces, ſo as to make in the whole ſixteen ounces, to be called the *acid mixture*. Let the patient take half an ounce (in meaſure) of the *alkaline mixture*, in three ounces of common water, four times

times a day; and immediately afterwards, let him take half an ounce of the *acid mixture*, in the ſame quantity of water; and continue theſe medicines, till the ſcorbutic ſymptoms diſappear, and the patient's ſtrength be reſtored; which may be expected to happen in about the ſpace of three weeks. If occaſion ſhould require, the doſe may be increaſed to double the quantity. In this compoſition the acid, by deſign, is made predominant." *(y)*

Dr. Hulme relates the hiſtory of one ſcorbutic patient, whoſe complaints were removed by the uſe of this medicine.

After having thus treated of the effects of Fixed Air in diſeaſes of the putrid claſs, I ſhall in the two ſubſequent ſections, as a further illuſtration of this ſubject, make ſome obſervations and experiments on putrefaction.

(y) A ſafe and eaſy remedy, &c. p. 11.

SECTION IV.

Of PUTREFACTION, the PUTRID EFFLUVIUM, and the means of correcting the PUTRID EFFLUVIUM.

Putrefaction is the great proceſs appointed by the CREATOR, for the reſolution of animal and vegetable ſubſtances into the elements from which they were firſt formed. By this proceſs, the oak and the bramble, the cedar and the hyſſop, fruits whether delicious and nutritive, or acrid and poiſonous, the moſt beautiful of the human ſpecies, and the moſt deformed of any of the other tribes of animals, are all reduced to one common lot; nor are the elements to which they return to be diſtinguiſhed from each other.

This reſolution of bodies, when philoſophically conſidered, is equally wonderful with their formation; and is alike governed by regular and invariable laws. Every ſeed produces its own plant,

plant, and every animal brings forth one of its own ſpecies; they live, they are nouriſhed, and each retains it's individual nature; they die, they decay, return to their elementary ſtate, and are again employed as the conſtituent parts of other vegetables and other animals. Such, with reſpect to the material part of the creation, is the amazing circle of Life and Death! A circle in which Nature keeps her ſteady rounds, and moves agreeable to laws fixed by the ALMIGHTY.

Sir *Iſaac Newton* very aptly illuſtrates this ſtability in the Laws of Nature. "While the primitive particles of matter continue entire, they may compoſe bodies of one and the ſame nature and texture in all ages: but ſhould they wear away or break in pieces, the nature of things depending on them would be changed. Water and earth compoſed of old worn

" particles and fragments of particles,
" would not be of the ſame nature and
" texture now, with water and earth
" compoſed of entire particles in the
" beginning. And therefore, that Na-
" ture may be laſting, the changes of
" corporeal things are to be placed
" only in the various ſeparations and
" new aſſociations and motions of theſe
" permanent particles; compound bo-
" dies being apt to break, not in the
" midſt of ſolid particles, but where
" thoſe particles are laid together, and
" only touch in a few points." *(z)*

During the reſolution of bodies by putrefaction, a conſiderable proportion of their parts is volatiliſed; and the *effluvia* thus thrown off, are more or leſs pernicious, according to the circumſtances which accompany the putrefactive proceſs.

(z) See Sir Iſaac Newton's Queries, at the end of his Optics, 8vo. 3d edition, page 376.

1. *Animal effluvia*, from the living body even in health, are not to be conſidered as innocent. When accumulated, and repeatedly reſpired, they are well known to be prejudicial to the animal œconomy, diminiſh the energy of the brain and nervous ſyſtem, and weaken the action of the heart and arteries. Hence the pale complexions, numerous diſeaſes, and anticipated deaths, of thoſe who inhabit large towns and populous cities.

2. *Church-yards* are another ſource of noxious *effluvia*. Theſe are generally formed in the midſt of crowded towns; and the more crowded the towns, the more conſtantly are they broken up. One generation is removed to make room for another; and I have ſeen bodies yet *green in death*, forced from the grave, and expoſed to the open day! Health, humanity, decency, cry aloud againſt ſuch barbarities.

3. *In*

3. *In Poor-houſes, Charity-ſchools,* and other places in which numbers are crowded under the ſame roof, and ſleep in the ſame apartment, the pernicious effects of putrid *effluvia* are likewiſe eaſily traced. There is ſomething peculiarly diſagreeable and debilitating, in the ſmell of ſuch apartments. Hence probably we are led to the principal cauſe why ſcrophulous complaints are ſo prevalent in charity-ſchools and poor-houſes; for as the children are conſtantly ſurrounded with an acrid atmoſphere of their own effluvia, their conſtitutions are vitiated, and an early and habitual debility produced.

It is an obſervation made by Dr. Prieſtley, "that young mice will always live much longer than old ones, or than thoſe which are full grown, when they are confined in the ſame quantity of air. I have ſometimes known a young mouſe to live ſix hours in the ſame cir-

cumſtances

cumſtances in which an old mouſe has not lived one." *(a)* With reſpect to the human ſpecies, in ſituations ſomewhat analogous to the above, the effects appear to be the reverſe; for in crowded and ill aired poor-houſes, old people are comparatively little injured, while the children become weak and ſickly; and when putrid fevers break out in ſuch places, the young ſubjects are generally firſt attacked.

4. *Hoſpitals* injudiciouſly built, and which, from their conſtruction, cannot have a full and free ventilation, are likewiſe infeſted with putrid *effluvia*. Hence the ſource of that fever which is peculiar to hoſpitals; a fever which may be ſaid to be indigenous, and which will always prevail in proportion to the vitiated ſtate of the air.

On this ſubject we have ſome very

(a) Experiments on Air, vol. 1, p. 72.

uſeful

uſeful obſervations by my ingenious friend Mr. Aikin, in his *Thoughts on hoſpitals.*

5. *In Jails and Priſons*, where the putrid *effluvium* is ſtill more cloſely confined, the effects are too often fatally marked by the *Jail Fever*. This fever has in ſome inſtances been propagated beyond the jails, and produced great havock; of which the *black aſſize* at Oxford, in the year 1577, was a dreadful example; when the judges, gentry, and almoſt all who were preſent, to the number of three hundred, were killed by a poiſonous vapour. This vapour was thought by ſome to have broken forth from the earth; but more juſtly ſuppoſed, by Lord Bacon, to have been brought by the priſoners out of the jail into the court; for it was obſerved that the priſoners were the only perſons not injured by this vapour. *(b)*

(b) Camden. Annal. Regin. Eliz. And Ld. Bacon's Natural Hiſtory, cent. 10, num. 194.

6. The

6. The *Plague*, which is a fever of a ſtill more malignant nature, ariſes from the *putrid effluvium* exalted by certain circumſtances and in certain climates, into a yet more dangerous *miaſma*; and which, as it ſpreads, forms the moſt deſtructive *contagion*. In ſome inſtances, this contagion arreſts as it were the vital powers, and proves almoſt inſtantly fatal. In the year 1726, an Engliſh ſhip took in goods at Grand Cairo, in the time of the plague's raging there, and carried them to Alexandria. Upon opening one of the bales in a field, two Turks, who were employed in the work, were immediately killed. *(c)* It was likewiſe obſerved, that the porters who opened the infected bales of goods in the lazarettos of Marſeilles, died upon the firſt appearance of infection; they were ſeized with rigors, tremblings, ſickneſs, vomitings, and giddineſs and heavineſs of the head; there was an univerſal languor

(c) Mead on the Plague, p. 198.

and inquietude, the pulſe low and unequal, and death enſued ſometimes in a few hours. *(d)*

The *Putrid Effluvium* is thus noxious in different degrees, according to the circumſtances which accompany either its production or confinement. Nature is wiſely, however, and uniformly employed, in ſo changing this product of putrefaction, as to render it generally either innocent or uſeful. Was not this the caſe, the quantity accumulated would be ſoon ſo great, as to deſtroy the whole race of mankind.

It is not eaſy to trace out the ſteps which nature takes, to accompliſh this her ſalutary purpoſe, but it is probable that the following will be found to have conſiderable efficacy.

1. *Diſperſion.* The *Effluvia* which ariſe

(d) Mead on the Plague, p. 186.

during

during the putrefactive proceſs, become leſs and leſs injurious in proportion as they are diſperſed and diluted. Hence the good effects of a free ventilation in hoſpitals, poor-houſes, jails, and wherever animal exhalations are collected; and of briſk gales and high winds, in changing the atmoſpheres of cities and large towns.

2. *Vegetation.* Air which has been rendered unwholeſome by reſpiration or putrefaction, is meliorated and again made fit for the ſupport of animal life by the growth of vegetables. This is a diſcovery, as curious as it is important; and for which we are indebted to the experiments and ſagacity of Dr. Prieſtley. "In no other circumſtances have I ever ſeen vegetation ſo vigorous as in air freſhly and ſtrongly tainted with putrefaction, and which is immediately fatal to animal life. Though theſe plants have been crowded in jars

filled with this air, every leaf has been full of life; freſh ſhoots have branched out in various directions, and have grown much faſter than other ſimilar plants, growing in the ſame expoſure in common air.

"This obſervation led me to conclude, that plants, inſtead of affecting the air in the ſame manner with animal reſpiration, reverſe the effects of breathing, and tend to keep the atmoſphere ſweet and wholſome, when it is become noxious, in conſequence of animals either living and breathing, or dying and putrefying in it." *(e)* This concluſion appears to have been clearly and fully eſtabliſhed by Dr. Prieſtley's ſubſequent experiments and obſervations.

3. *The completion of the putrefactive proceſs*, and the conſequent return of the putrefying ſubject to its elementary

(e) Dr. Prieſtley's Experiments on Air, vol. 1, p. 86.

ſtate,

ſtate, form another means employed by nature for the reſtoration of noxious air.

By the digeſtive proceſs, the aliment is ſo changed as to become a part of the animal which it nouriſhes; and by the putrefactive proceſs, this animal paſſes into a ſtate of diſſolution, loſes its texture and organization, and riſes into the air in the form of vapour. Part of this vapour is abſorbed by growing vegetables, nouriſhes and becomes a part of their ſubſtance; and thus the air is ſo far freed from the noxious impregnation. What remains is ſtill further diſperſed, and paſſing, by the wiſe proviſion of nature, thro' various changes and combinations, returns to the ſtate of elements; and theſe elements become again the conſtituent parts of other vegetables and other animals.

4. *Fire and ſmoke* have likewiſe been found powerful correctors of putrid *effluvia*, and of the infectious *miaſmata* which excite putrid fevers. The accurate and judicious Dr. Lind ſays, "I ſeldom or ever knew a proper application of fire and ſmoke to be unſucceſsful in producing the happy conſequence of effectually purifying all tainted places, materials and ſubſtances." *(f)* In another place he ſays, "a proper application of fire and ſmoke, is the true means appropriated for the deſtruction and utter extinction of the moſt malignant ſources of diſeaſe. They are beſides the greateſt purifiers of all bad and tainted air." *(g)* Theſe however are to be conſidered rather as artificial than natural means of correcting putrid *effluvia*; and to do it effectually, the heat and ſmoke of the burning mate-

(f) Two papers on fevers and infection, p. 44.
(g) Ibid. p. 49.

rials,

rials, muſt be long and cloſely ſhut up wherever the contagion is ſuppoſed to lurk.

5. *Fixed Air* has alſo been ſuppoſed to have the power of ſweetening the putrid effluvium, and of thus meliorating air which has been tainted by putrefaction. This point will be examined in the next ſection, which treats of the relation of Fixed Air to putrefaction and the putrid effluvium.

SECTION V.

Of the Effects of FIXED AIR, on the PUTREFACTIVE PROCESS and on the PUTRID EFFLUVIUM.

I. A German writer of the laſt century, relates a ſingular fact, which proves the antiſeptic power of Fixed Air. The waters of *Schwalbach* in the Landgravate of Heſſe, are ſo ſtrongly impregnated with Fixed Air, that it is thrown off in large quantities into ſome rocky

rocky caverns, through which theſe waters paſs before they iſſue to the day. Merian, in his *Topographia*, takes notice, that every kind of animal ſubſtance is preſerved in theſe cells from putrefaction. "*In æſtuoſiſſima etiam æſtate carnes quaſcunque abſque omni putredine et fœtore conſervari.*" *(h)*

Merian thus points out the effects of this volatile principle, without being acquainted with the true nature of the principle itſelf. The Hon. Mr. Boyle was the firſt who aſcertained the *antiſeptic* power of ſome kinds of factitious air; Sir John Pringle diſcovered, that putrid ſubſtances were *ſweetened* by being immerſed either in fermenting or efferveſcing mixtures; and Dr. Macbride has clearly proved, that it is the *Fixed Air* produced in theſe mixtures, which recovers putrid ſubſtances to a ſtate of ſweetneſs.

(h) Merian *Topographia Haſſiæ*. p. 123, et 127.

Some

Some ingenious conjectures have been made, with reſpect to the manner in which Fixed Air operates, either in preventing putrefaction, or in ſweetening thoſe ſubſtances which are already become putrid.

" How are we to explain, ſays Dr. Percival, the ſweetening powers of Fixed Air? An eminent philoſopher ſeems to hint that Fixed Air may act as a *menſtruum* for the putrid *effluvium*, and thus imbibe or diſcharge it from the ſeptic body." *(i)*

Mr. Henry likewiſe ſays, " There appears to be ſome degree of probability, that Fixed Air, in reſtoring ſweetneſs to putrid bodies, produces this effect, by acting as a *menſtruum* to the putrid *effluvia*." *(k)* This ſuppoſition was ſuggeſted to Mr. Henry by the following

(i) Eſſays Medic. and Exper. vol. 2, p. 83.

(k) Experiments and Obſervations, p. 142.

experiment: " A piece of putrid beef, after having been ſuſpended in an atmoſphere of Fixed Air for thirteen hours, was very conſiderably, though not entirely ſweetened. *But the air in the bottle ſeemed to have acquired all the putrid ſmell of which the fleſh had been deprived.*" *(l)*

Now if the ſweetening power of Fixed Air, ariſes from its acting as a menſtruum to the putrid effluvium, whence is it, that in putrid fevers, in which the whole habit is affected, the putrid proceſs is checked by even ſmall quantities of Fixed Air, taken either by the mouth or adminiſtred in clyſters? We cannot ſuppoſe, that the putrid effluvium, in conſequence of its ſtrong affinity with Fixed Air, is abſtracted from the whole ſyſtem; or if it was, that it would be rendered innoxious; for it appears from Mr. Henry's Experiment,

(l) Henry's Exp. and Obſerv. p. 122.

that

that it ſtill retains its offenſive ſmell, tho' united with Fixed Air. Beſides, *mere abſtraction* of the putrid effluvium affords only a partial ſolution of the queſtion; and does not explain, whence it is that the *further production* of the putrid effluvium is prevented: an effect, which does not proceed from abſtraction, but from the power which Fixed Air actually poſſeſſes, *of putting a ſtop to the putrefactive proceſs*. For if the cauſe be thus removed, the effect will ceaſe of courſe. Hitherto, therefore, no further advance has been made on this ſubject, than to aſcertain, *that Fixed Air deſtroys the putrefactive fermentation*.

As to the explanation of that power in Fixed Air, by which it *retards* or even *prevents* putrefaction, nothing ſatisfactory appears yet to have been ſuggeſted.

Dr. Alexander has endeavoured to

eſtabliſh a very extraordinary doctrine, which is, that bodies are preſerved from putrefaction by being ſurrounded with putrid matter. Conformable to this idea, Doctor Percival conjectures, *(m)* " that Fixed Air may reſtrain and even " prevent putrefaction, without poſſeſſ- " ing any inherent antiſeptic quality. " For by ſurrounding the putreſcent " ſubſtance with that kind of air, which " it yields by putrefaction, and which " requires ſome vehicle to diſcharge or " carry it off, the ſeparation of it is " prevented, and the body thus re- " tained in its original ſtate." Dr. Prieſtley likewiſe ſays, " I think it pro- " bable enough, that putrid matter, as " Dr. Alexander has endeavoured to " prove, will preſerve other ſubſtances " from putrefaction; becauſe being al- " ready ſaturated with the putrid efflu- " vium, it cannot readily take more." *(n)*

(m) Eſſays Med. and Exp. vol. 2, p. 81.

(n) Exp. and Obſerv. vol. 1, p. 197.

To

To determine this point, I made the following experiments:

EXPERIMENT I.

A piece of freſh mutton was ſuſpended by a thread in a phial which held twenty ounces; at the bottom of this phial lay ſome putrid fleſh, and the phial was corked. A piece of the ſame mutton was in like manner ſuſpended in another phial, which contained nothing but common air, and this phial was likewiſe corked. At the end of twelve hours, I examined the firſt piece of mutton, after waſhing it well for five minutes in freſh water, and found it very offenſive. The piece in the other phial was perfectly ſweet.

EXPERIMENT II.

Two pieces of freſh veal were ſuſpended in the ſame manner for fifty-four hours; that in the putrid air was tender

tender and very offenſive, while the other piece remained ſtill ſweet.

It is ſurpriſing to obſerve the extravagant and even dangerous concluſions, to which medical writers have ſometimes been led by falſe theories or miſtaken facts. Of this we have a ſtriking inſtance in Dr. Alexander's *Experimental Inquiry*, where he quotes two paſſages, one from Benet and the other from Pictorius. *(o)* "Among the more rude "and barbarous nations, ſays Dr. Alex-"ander, we frequently meet with cuſ-"toms which at firſt view ſeem totally "repugnant and irreconcileable to rea-"ſon; and yet upon conſidering them "more attentively, we generally find "that they have ſome foundation in "nature, and have taken their riſe from "experience and obſervation. Thus "we are told by Alexander Benedictus,

(o) Exp. Inquiry concerning the cauſes of putrid diſeaſes, p. 75, 76.

"that

" that a phyſician among the Tartars,
" in the time of a ſevere plague, or-
" dered all the dogs to be killed and
" thrown into the moſt public ſtreets
" and roads, that the atmoſphere might
" be filled with a putrid ſmell; by which
" means, he ſays, the people were re-
" ſtored to health, and that they con-
" tinue ſtill the ſame practice in like
" caſes. *(p)* And ſimilar to this, we
" are alſo informed by Gregorius Pic-
" torius, that he had heard ſome per-
" ſon affirm, that in the time of an
" epidemic infection, nothing was bet-
" ter or more ſalutary, than for every
" one to ſmell, three times a day, ei-
" ther a neceſſary-houſe or a ſheep-
" houſe. *(q)* Is it poſſible that theſe
" cuſtoms, ſeemingly ſo contradictory
" to reaſon, could ariſe from chance;
" were they not rather deduced from
" obſervations ſimilar to thoſe above re-

(p) Alex. Benedict. de Peſte, cap. 6.

(q) Greg. Pictor. Dialog. 2, de bona valetudine.

" lated

" lated concerning excrement and marſh
" water ?"

Such facts, and ſuch concluſions, require no comment ! They only ſhow to what ſtrange extremes, ingenuity may ſometimes be ſubtilized.

The queſtion whether putrid marſhes are or are not unwholeſome, is a queſtion of conſiderable moment; Doctor Prieſtley therefore, by a clear and concluſive experiment, has proved, that the vapour which ariſes from putrid water is exceedingly noxious, and thus guards againſt the miſchief which might proceed from a careleſs belief of the doctrine advanced by Dr. Alexander. " Happening, ſays Dr. Prieſtley, to uſe at Calne a much larger trough of water, for the purpoſe of my experiments, than I had done at Leeds, and not having freſh water ſo near at hand as I had there, I neglected to change it, till it turned

turned black and became offenſive, but by no means to ſuch a degree, as to determine me from making uſe of it. In this ſtate of the water, I obſerved bubbles of air to riſe from it, and eſpecially in one place, to which ſome ſhelves, that I had in it, directed them; and having ſet an inverted glaſs veſſel to catch them, in a few days I collected a conſiderable quantity of this air, which iſſued ſpontaneouſly from the putrid water; and putting nitrous air to it, I found that no change of colour or diminution enſued, ſo that it muſt have been in the higheſt degree, noxious." *(r)*

The celebrated Dr. Franklin, has likewiſe pointed out the pernicious effects of the *Marſh effluvium*. Speaking of the flame which may be lighted up on the ſurface of ſome American waters: "I have tried, ſays this excellent philoſopher, the experiment twice here in Eng-

(r) Experiments on Air, vol. 1, p. 198.

land, but without ſucceſs. The firſt was in a ſlow running water, with a muddy bottom. The ſecond, in a ſtagnant water at the bottom of a deep ditch. Being ſome time employed in ſtirring this water, I aſcribed an intermitting fever, which ſeized me a few days after, to my breathing too much of that foul air which I ſtirred up from the bottom, and which I could not avoid while I ſtooped in endeavouring to kindle it." *(f)*

II. The effects of Fixed Air on the putrefactive fermentation having been thus conſidered, the next inquiry is into the effects of this fluid on the *product* of putrefaction or the proper putrid *effluvium*.

It appears to be the general opinion, that Fixed Air meliorates and ſweetens air which has been rendered noxious by

(f) Dr. Prieſtley's Experiments, vol. 1, p. 323:

reſpiration

reſpiration or putrefaction; and Dr. Prieſtley's experiments ſeem to favour this opinion. "Having found, ſays the Doctor, by ſeveral experiments above mentioned, that the proper putrid effluvium, is ſomething quite diſtinct from Fixed Air, and finding, by the experiments of Dr. Macbride, that Fixed Air corrects putrefaction; it occurred to me, that Fixed Air, and air tainted with putrefaction, tho' equally noxious when ſeparate, might make a wholeſome mixture, the one correcting the other; and I was confirmed in this opinion by, I believe, not leſs than fifty or ſixty inſtances, in which air, that had been made in the higheſt degree noxious, by reſpiration or putrefaction, was ſo far ſweetened, by a mixture of about four times as much Fixed Air, that afterwards mice lived in it exceedingly well, and in ſome caſes almoſt as long as in common air.

" The reaſon why I do not abſolutely conclude that the reſtoration of air in theſe caſes, was the effect of Fixed Air, is, that when I made a trial of the mixture, I ſometimes agitated the two kinds of air pretty ſtrongly together, in a trough of water, or at leaſt paſſed it ſeveral times through water, from one jar to another, that the ſuperfluous Fixed Air might be abſorbed, not ſuſpecting at that time that the agitation could have any other effect. But having ſince found, that very violent, and eſpecially long continued agitation in water, without any mixture of Fixed Air, never failed to render any kind of noxious air in ſome meaſure fit for reſpiration, I began to entertain ſome doubt of the efficacy of Fixed Air in this caſe. In ſome caſes alſo, the mixtures of Fixed Air had by no means ſo much effect on the putrid air, as from the generality of my obſervations, I ſhould have expected.

" Upon

"Upon the whole, I am inclined to think that this proceſs could hardly have ſucceeded ſo well as it did with me, and in ſo great a number of trials, unleſs Fixed Air have ſome tendency to correct air tainted with reſpiration or putrefaction; and it is perfectly agreeable to the analogy of Dr. Macbride's diſcoveries, and may naturally be expected from them, that it ſhould have ſuch an effect." *(t)*

As Dr. Prieſtley has ſuggeſted a doubt with reſpect to the concluſiveneſs of his own experiments, from the circumſtance of the two kinds of air being agitated together in water; I determined to repeat the experiments in a manner, which could admit of no ſuch doubt. The experiments were made by means of an *Eudiometer*, with which I was obligingly furniſhed by Dr. Falconer. It is a graduated glaſs tube, about ſixteen

(t) Prieſtley's Experiments on Air, vol. 1, p. 98.

inches

inches in height, and three fourths of an inch in diameter, and which at the lower end, beneath the graduations, opens into a trumpet-mouth for the convenience of ſtanding. The graduated part of the tube is formed into ſix diviſions, each diviſion containing one meaſure; and each meaſure is again ſubdivided into ſixteen parts, ſo that the diminution on the admixture of different kinds of air may be accurately marked.

It is further to be obſerved, that both the nitrous air and the Fixed Air were freſh made. The nitrous air, from clean copper filings and ſtrong ſmoking ſpirit of nitre, diluted with about ſix times its quantity of water; and that the nitrous acid might be quite pure and free from the marine, it was procured from the cryſtals of nitre by means of the vitriolic acid.

To

To determine what diminution a given quantity of Fixed Air ſuffers, in paſſing through a column of water of a given height, I made

EXPERIMENT I.

Two meaſures of Fixed Air in paſſing through the water in the *Eudiometer*, loſt rather more than half a meaſure: and from four meaſures tried in the ſame manner, there was a diminution of one meaſure. So that a fourth part of a given quantity of Fixed Air, is abſorbed as it riſes through a column of water of about fourteen inches in height.

To aſcertain whether there is any diminution on the mixture of Nitrous Air with Fixed Air, I made

EXPERIMENT II.

One meaſure of Nitrous Air was added to four meaſures of Fixed Air, and there was a diminution of one ſixteenth of

of a meaſure. This experiment was ſeveral times repeated, and the diminution was always nearly the ſame.

Theſe particulars being premiſed, I proceeded to the experiments on the putrid *effluvium* or air tainted with the product of putrefaction.

EXPERIMENT III.

To one meaſure of highly putrid air, was added one meaſure of Nitrous Air, and without any diminution; a proof that the putrid air was perfectly noxious.

EXPERIMENT IV.

To one meaſure of the ſame putrid air, were added four meaſures of Fixed Air; and to determine whether the putrid air was meliorated by this addition, one meaſure of Nitrous Air was added as a teſt. There was a diminution only of one ſixteenth of a meaſure. This

experiment

experiment was frequently repeated; and it was always found, that there was no further diminution, than what would have ariſen from adding one meaſure of nitrous air to four meaſures of Fixed Air. Conſequently there had been no melioration of the Putrid Air, by its admixture with the Fixed Air.

As I wiſhed to have the reſult of this experiment clearly aſcertained, I requeſted Mr. Henry, of Mancheſter, to take the trouble of repeating it. This requeſt was readily complied with, and Mr. Henry, without being acquainted with the particulars of my experiment, tranſmitted to me by letter, the follow- account of one made by himſelf.

EXPERIMENT V.

" One meaſure of Nitrous Air, added to two of highly Putrid Air, produced no diminution. I then mixed one meaſure of the ſame Putrid Air with

two meaſures of Fixed Air, and put it to the teſt of one meaſure of Nitrous Air. As ſoon as they were mixed, I perceived the water to riſe in the *Eudiometer*, and on reckoning the diminution which had taken place, I found it to be ſomething more than 1-20th.

" The air was rendered putrid by placing a piece of mutton in a bottle, which was ſuffered to putrefy before the bottle was corked. It was then ſtopped cloſely from the external air, and never opened till the experiment was made, when it was uncorked under water."

It appears however from experiments II. and IV. that the ſmall diminution here marked by Mr. Henry, proceeded from the mixture of the Nitrous Air with the Fixed Air, and not from the melioration of the Putrid Air.

The concluſion to be drawn from the preceding

preceding inquiry, is this; that there is a diſtinction to be made between putrefaction, and the product of putrefaction; and that Fixed Air checks or puts a ſtop to the putrefactive fermentation, but does not meliorate or ſweeten the putrid effluvium the product of putrefaction. Hence we ſee, why in Mr. Henry's experiment the tainted beef was ſweetened, while the air in the bottle remained very offenſive. Hence likewiſe we ſee, why *lime kilns* in the neighbourhood of populous cities, or large veſſels of fermenting liquors placed in rooms filled with noxious air, can have no effect in meliorating this, except the Fixed Air which is thrown out, come in contact with the putrefying body; it may then indeed check the putrid fermentation, and thus be of uſe by cutting off the ſource whence the putrid effluvium is derived.

SECTION VI.

Of the Uſe of Fixed Air in Cachexies, and Phagedenic Ulcers.

In genuine and confirmed cancers, I have never found any ſenſible progreſs towards a cure, or any conſiderable benefit, further than a mitigation of the pain, from the uſe of Fixed Air: but in old, ſpreading, ill-conditioned ulcers, I have employed this remedy with obvious advantage. It has in many inſtances relieved the pain, brought on a more favourable digeſtion, and much improved the appearance of the ulcers; and in ſome, it has effected a complete cure.

CASE I.

James Rider, about thirty-ſix years of age, was made an out-patient of the hoſpital, April 8, 1773. He had been afflicted for more than two years, with a painful ulcer, which was ſpreading

ing over the roof of the mouth. On examining the part, I found the ulcer of an irregular and jagged ſurface, with a diſagreeable ſmell; and it had extended itſelf over the *velum pendulum palati*, and the greateſt part of the arch of the mouth.

He took the ſolution of the *corroſive ſublimate* in the manner now generally directed, and two ſcruples of powdered *ſarſaparilla* three times a day. The ulcerated part was likewiſe well waſhed, with the common gargle and tincture of myrrh. Theſe remedies were continued for fourteen days, without producing any appearance of amendment. He was directed therefore to take the effervеſcing draught three times a day.

The pain abated, the diſeaſed part put on a more kindly aſpect, and was perfectly healed by the eighth of May. The Fixed Air was not in any other manner

manner immediately applied to the ulcer, than as it came in contact with it during his ſwallowing the effervеſcing mixture. I ſaw him ſeveral weeks after this, and on examining the mouth found it perfectly ſound.

In ſome inſtances, it is neceſſary to perſevere for a long time in the ſteady uſe of this medicine, to complete the cure, as appears from the ſubſequent hiſtory.

CASE II.

Elizabeth Cox, forty years of age, became an out-patient of the hoſpital September the 2d, 1773. Six months before this, ſhe began to be troubled with what ſhe called a very painful ſore throat. On examination, it appeared that the *velum pendulum*, and inſide of the noſtrils, were affected with a ſpreading ulcer. There was a conſiderable diſcharge of matter from the noſtrils,

noſtrils, with very ſevere pains in the back and internal part of the noſe: The ulcer had eaten thro' the *velum pendulum*, forming a circular opening about the ſize of a ſilver penny, and had ſpread ſo far along the back of the fauces and into the noſe, as to be viſible on looking into the noſtrils. The diſcharge was offenſive, ſometimes mixed with little clots of blood, and at other times ſmall pieces of bone came away with the matter; the ſenſe of ſmelling was entirely loſt.

I directed the uſual doſe of the *ſublimate ſolution*, and a quart of malt infuſion to be drank daily; and the parts were well waſhed with barley water and tincture of myrrh. She continued this courſe for about twelve days, but without the leaſt check to the progreſs of the ulcer; on the contrary, the whole of the *velum pendulum* was now almoſt deſtroyed, ſo as to form an opening of a very

a very terrible aſpect into the upper and back part of the fauces; nor was the violence of the pains at all diminiſhed.

She was at this time made an in-patient; and took a ſcruple of ſalt of tartar, with a ſpoonful of lemon juice every ſix hours, and had the diſeaſed parts well fumigated with the Fixed Air of chalk detached by the acid of vitriol. After purſuing this plan for about five weeks, the pains were very inconſiderable, and the ulcerated *velum pendulum* quite healed; the diſcharge from the noſtrils was much diminiſhed, and conſiſted of well-formed *pus*, and here likewiſe the ulcerated parts were in a very favourable and healing ſtate. But at this time ſhe complained much of a pain in her throat, very different ſhe ſaid from what ſhe had hitherto felt; and on inſpection, there was diſcovered a large venereal ulcer on one of the tonſils. Whether this was an

infection

infection of long ſtanding, or had been lately contracted, in conſequence of her having again been made an out-patient, I could not diſcover. By taking however the *ſublimate ſolution* for three weeks, then applying the mercurial ointment for about three weeks longer, ſo as ſlightly to affect the mouth, and drinking a decoction of ſarſaparilla, the venereal complaint was entirely removed.

During the mercurial courſe, the former complaints became worſe, the pain increaſed, and the diſcharge was again thin and offenſive. The effervеſcing draughts therefore, and the fumigation with Fixed Air, were directed as before; and by ſteadily perſevering in the uſe of theſe means for ten weeks, ſhe was perfectly cured.

I have ſeen the ſame good effects, from this method of cure, in other caſes

of phagedenic ulcers; but was diſappointed in my expectations with reſpect to the following patient.

CASE III.

Jane Dean was an out-patient of the hoſpital, for complaints much reſembling thoſe of Elizabeth Cox. After ſeveral powerful remedies had been tried without relief, a conſultation was deſired. On this occaſion, I mentioned the good effects I had experienced in ſome ſimilar caſes from the uſe of Fixed Air; and it was agreed, that ſhe ſhould take the efferveſcing draughts, and have the parts well fumigated with Fixed Air, as in the preceding caſe.

After ſome time, the appearances were very flattering, the pains entirely ceaſed, and the ulcerated parts were almoſt perfectly healed. On the return however of cold weather, this patient relapſed; and neither the external or internal

internal uſe of Fixed Air, had then the ſame happy effects. Nor had I an opportunity of trying whether her ſteadily purſuing the ſame plan as an *in-patient*, would have been more ſucceſsful; for ſhe came from a diſtance in the country, and deſiſted from attending the hoſpital.

As the caſe of the following patient was attended with ſome ſingular appearances, tho' not with ulceration, I ſhall tranſcribe it.

CASE IV.

Mrs. C, 30 years of age, in the ſummer of 1774, was afflicted with ſevere rheumatic pains of the head, neck, ſhoulders, and arms; which, notwithſtanding the uſe of ſeveral powerful remedies, continued to be very troubleſome for two or three weeks. She then began to complain of ſoreneſs in the throat, with a painful and difficult de-

glutition. It appeared, on inſpection, that the tonſils and back part of the fauces were covered with ſomething which much reſembled *Pus*, and which adhered ſo firmly, that it could not be wiped away. From the commencement of this ſore throat, the rheumatic pains were much relieved.

A bliſter was put between the ſhoulders, and ſeveral topical applications were uſed to the fauces, but without effect. Nothing gave ſo much eaſe, or diſpoſed the adhering matter to ſeparate ſo freely, as Fixed Air. She took the effervеſcing draughts, and the throat was fumigated in the uſual manner.

When the parts were by theſe means cleared, they were red, but there were no marks of ulceration. The matter therefore with which the tonſils and fauces were covered, appears to have been the ſame with what Dr. Hunter,

in

in his excellent paper on the *emphyſema* and cellular membrane, calls an *inflammatory exudation*. *(u)*

This ſingular affection of the throat, ſeems to have been a rheumatic *metaſtaſis*; for the ſore throat twice alternated with the rheumatic pains of the head, ſhoulders and neck.

CASE V.

In November 1776, I met with a caſe ſimilar to the preceding, with this difference, that the affection of the fauces did not alternate with any rheumatic pains. Miſs C. during the courſe of a continued fever, began to complain of ſoreneſs and uneaſineſs in the throat. When examined, the *uvula*, *velum pendulum*, tonſils and back parts of the fauces, were found ſpotted over with a ſubſtance which had the appearance of cream or whitiſh *Pus*. This

(u) Medic. Obſervations and Inquiries, vol. 2, p. 61: ſubſtance

ſubſtance adhered firmly, was raiſed above the ſkin, and in the interſtices the *cutis* was red and inflamed. Different gargles, and other applications were tried without effect; but the efferveſcing draughts, and the fumigation with Fixed Air, ſoon eaſed the pain, cleared the *fauces*, and removed the complaint.

From conſidering Fixed Air both as a tonic and as a corrector of acrimony, I was induced to give it to ſeveral SCROPHULOUS patients: in ſome, it has afforded ſenſible relief; but in none, ſo far as my preſent experience goes, has it effected a cure. In other cachexies, it has ſometimes been more ſucceſsfully adminiſtred.

CASE VI.

Mrs. C. an unmarried lady, about fifty years of age, had been a valetudinarian for ſome time; was in a bad habit

habit of body, and had been afflicted with the jaundice for five weeks.

I firſt ſaw her in September 1772. She then complained of conſtant ſickneſs, loathed food, reached frequently and ſometimes vomited. The ſtools were white, there was a deep yellow over the whole body, and great tenderneſs on preſſing upon the region of the liver. The urine was paſſed in ſmall quantities, and tinged every thing it touched with the colour of ſaffron. The pulſe from 85 to 105. She grew worſe towards the evening, was hot and reſtleſs during the night, and ſo weak as to be able to ſit up only for a few hours. She was much troubled with wind, and an uneaſy tenſion about the ſtomach. Rhubarb with ſoap, and the common ſaline mixture, had been given for more than two months, but without affording relief, for ſhe daily became worſe.

One

One ſcruple of ſalt of tartar was directed to be taken with lemon juice in the ſtate of efferveſcence, and repeated three times in the day. Her ſtomach became more ſettled, the ſickneſs by degrees left her, the vomitings entirely ceaſed, the fever was diminiſhed, and the nights more eaſy and compoſed, her appetite returned, and ſhe regained her ſtrength. The medicine was continued for ſeven weeks, and ſhe was then perfectly recovered. From the time of her beginning with the efferveſcing draughts the flatulent complaints were much leſs troubleſome.

This patient had a relapſe about two years after, and was cured by the uſe of the ſame remedy.

CASE VII.

Mary Tear was admitted an out-patient of the hoſpital, December 24, 1772. She had a ſingular kind of eruption

tion on the hands, arms and legs. The hands and arms were hot, and the heat was accompanied with prickling and itching; they were ſwelled likewiſe, moiſt, pimpled, and chapped. The legs were covered with ſmall bliſters, which on burſting diſcharged ſome ſerum, and then formed into ſcales. She had been afflicted with theſe complaints five or ſix months, and had taken ſeveral medicines without relief. The only medicine now directed for her, was the efferveſcing draught, to be taken three times a day.

January 2, 1773. The medicine acts as a diuretic, and keeps the body rather more open than uſual. The painful ſymptoms are relieved, and the diſeaſed parts put on more of their natural appearance.

Jan. 16. The arms are now well, and the legs nearly ſo. She was ordered to

go on with the medicine, and in about ten days more was perfectly free from the complaint.

I have ſeen a number of ſimilar inſtances, in which Fixed Air thus adminiſtred, has been equally ſucceſsful: and that the efficacy of the medicine depends upon the Fixed Air, and not upon the neutral ſalt, appears particularly from the 6th of theſe caſes, and from others likewiſe, in which I had previouſly given the neutral ſalts for a ſufficient length of time, without any ſenſible diminution of the diſeaſe.

SECTION VII.

Of the Uſe of Fixed Air in ſome diſeaſes of the Stomach.

Thoſe mineral waters which contain Fixed Air, have been drank with advantage in a debilitated and too irritable ſtate of the ſtomach, in loſs of appetite, and in habitual nauſea and vomiting.

vomiting. As the good effects in theſe caſes, have with propriety been attributed to their Fixed Air, I wiſhed to try the ſame remedy in diſeaſes of this claſs, as detached in the effervesſcing draughts.

CASE I.

Mr. D. a young gentleman about 16 years of age, had for three years, almoſt entirely loſt his appetite; and had frequently a ſtrong averſion to every kind of aliment, eſpecially to animal food. Nothing would ſtay upon his ſtomach, except a little tea or ſago, and theſe were often rejected. Whenever he forced down any other kind of aliment, ſickneſs enſued, and the aliment was quickly returned.

He had tried emetics, the peruvian bark, change of air, ſea bathing, bitters, chalybeates, and other ſtrengthening remedies, to no purpoſe.

In October 1772, I directed the uſual effervesſcing draught to be taken three times a day. This medicine gradually produced an agreeable change. The ſickneſs and vomiting abated, and the appetite, though ſtill limited, was much altered for the better. By longer perſevering in the uſe of the medicine, he acquired ſtrength, and enjoys a good ſtate of health.

CASE II.

A Gentleman about ſixty years of age, had for ſeveral months a cough, frequent pulſe, ſlight chills, and ſometimes conſiderable night ſweats. He was much reduced by theſe complaints, *had loſt his appetite, and had an averſion to every kind of animal food.*

An emetic, the common ſaline mixture, the bark, and columbo root, had been given, but with little effect. He was

was ſtill very weak, the pulſe more than 100, and he could not bear either the ſmell or taſte of animal food. The efferveſcing draught was now given as in the preceding caſe, and indeed with ſurpriſing and almoſt inſtant relief; for in a very ſhort time, he could eat animal food with ſome degree of reliſh; and in a few days more, his appetite was reſtored to its natural ſtate. He continued the uſe of the medicine for three weeks; during which time he regained his ſtrength, the pulſe returned to 70, and he found himſelf he ſaid quite recovered.

CASE III.

Charles Wright was made an outpatient of the hoſpital in November 1773. He was 25 years of age, and had been afflicted for two months with pain in the ſtomach, ſickneſs and vomiting. Whenever he eat any food, it loaded and oppreſſed his ſtomach, and after

after two or three hours a conſiderable quantity of it was rejected. He took the efferveſcing draught three times a day, and the complaints were entirely removed in twenty days.

CASE IV

Miſs A. a young Lady of 27 years of age, was bled in the arm on account of a very troubleſome cough and hoarſeneſs. During the following night, the orifice began to bleed afreſh, and as ſhe lived in the country, the loſs of blood was ſo great before ſhe could get proper aſſiſtance, that ſhe was very much enfeebled and extremely faint. The next day ſhe continued to be weak and languid, the ſtomach rejected every thing, and generally almoſt as ſoon as taken down. She continued in this ſtate for two days, and on the third I firſt ſaw her. The efferveſcing draughts gave immediate relief, the ſickneſs and reachings

reachings ceaſed, the food was retained, and ſhe ſoon gained ſtrength.

I have frequently directed Fixed Air in GOUTY affections of the ſtomach. In ſome inſtances it has removed the ſpaſms, and thrown the diſeaſe upon the extremities; in others, it has afforded no ſenſible relief.

The good effects of this medicine in the ſickneſs and vomitings which frequently occur in Fevers, are univerſally known. The *Formula* however which is directed by Boerhaave, is very different from that which was originally directed by Riverius. The following is Boerhaave's preſcription:

R. *Succi recentis citrei unc.* ſs. *Vin. Rhenani unc.* j. *bene miſtis adde ſalis abſinthii drach.* j. *In ipſo actu effervescentiæ potentur.* (x)

(x) *Materia Medica. ad nauſeam febrilem.*

The

The *formula*, as it ſtands in Riverius, is this. *Salis abſinthii ſcrupulus unus cum ſucci Limonum cochleari mixtus, remedium eſt præſtantiſſimum, præſertim in vomitu qui febribus malignis ſolet contingere. (y)*

The exceptions to Boerhaave's preſcription are, that the citron juice is a weaker acid than that of the lemon, and that the alkaline ſalt is directed in a much greater quantity than is neceſſary to ſaturate the acid; conſequently there will be a large portion of ſuperabundant alkali, which will aggravate rather than relieve the febrile ſymptoms.

SECTION VIII.

On the Uſe of Fixed Air in the Stone, Gravel, &c.

1. An accurate and ingenious philoſopher, the Hon. Henry Cavendiſh, has pointed out, by a connected train of experiments, that calcareous earths are made

made ſoluble in water, by being united with more than their natural proportion of Fixed Air. (y) A writer of eminence, however, doubts whether this concluſion be clearly eſtabliſhed. "Notwithſtanding this great authority, I hope I may be pardoned if I preſume to diſſent, as I acknowledge that gentleman's experiments, in order to prove this, though highly worthy attention, did not appear clearly to lead to that concluſion." (z) Some degree of addreſs indeed is neceſſary, ſatisfactorily to repeat the experiments of Mr. Cavendiſh. But there are two very eaſy experiments, which are concluſive on this ſubject, and which fully prove that the theory of Mr. Cavendiſh, is as true as it is ingenious. Let any one blow through a glaſs tube into a ſmall quantity of lime water; the lime water becomes turbid by the admixture with the

(y) Philoſoph. Tranſac. vol. 57, part 1, article 11.
(z) Falconer's Eſſay on Bath waters, vol. 1, p. 158.

Fixed Air from the lungs, and the calcareous earth is precipitated from the water, by being combined with *this proportion* of Fixed Air. Continue to blow in the ſame manner for ſome time longer, and the water will by degrees become perfectly clear, the calcareous earth being rediſſolved by a ſtill *larger proportion* of Fixed Air. Or, put a ſpoonful or two of lime water, into the middle glaſs of Dr. Nooth's *apparatus*, already nearly filled with common water, and then let continued ſtreams of Fixed Air be thrown into the water. The water will firſt become milky, and afterwards perfectly tranſparent. A ſmall proportion of lime water is here uſed, that the effect may be the ſooner obſerved; for was the middle glaſs to be filled with lime water only, a length of time would be neceſſary to complete the experiment.

2. This doctrine of the ſolution of calcareous earths, naturally ſuggeſted the

the idea of the ſolubility of the human *calculus* while yet in the bladder, by the regular and continued uſe of Fixed Air. Dr. Saunders and Dr. Percival firſt inculcated this opinion; and the firſt of theſe gentlemen pointed out, that the diminution of *calculi* on being put into fermenting mixtures, as obſerved by Dr. Hales, was effected by the Fixed Air generated in theſe mixtures. The diminution likewiſe of ſome *calculi*, by being immerſed and macerated in water impregnated with Fixed Air, has been proved by the experiments of Doctors Saunders, Percival, and Falconer.

3. The next point to be aſcertained on this ſubject, is, whether this fluid may be ſo tranſmitted by the courſe of the circulation, as to enter the bladder unchanged, and the urine be thus ſufficiently medicated with Fixed Air? "It might be queſtioned, ſays Dr. Prieſtley, whether the Fixed Air contained in our aliments can be conveyed by the courſe

of circulation into the blood, and by that means impregnate the urine. I have found, however, that it may do it; having more than once expelled from a quantity of freſh-made urine, by means of heat, about one-fifth of its bulk of pure Fixed Air, as appeared by its precipitating lime from lime-water, and being almoſt wholly abſorbed by water; and yet a very good air-pump did not diſcover that it contained any air at all." *(a)* That the urine may be ſtill more copiouſly impregnated with Fixed Air, appears from the following fact related by Dr. Percival. "A young gentleman, Mr. Thomas Smith, has, at my deſire, taken large quantities of mephitic water daily, during the ſpace of a fortnight. And whilſt he continued this courſe, his urine was ſtrongly impregnated with Fixed Air, as appear'd from the precipitation which it produced in lime-water; from the bubbles which

(a) Exper. and Obſervat. on Air, vol. 2, p. 216.

it

it copiouſly emitted when placed under the receiver of an air-pump; and from the ſolution of ſeveral urinary ſtones, which were immerſed in it." *(b)*

The obſervations of practical writers, concerning the efficacy of thoſe mineral waters which contain a volatile principle, in calculous caſes, is a further argument in favour of this doctrine. That Fixed Air conſtitutes the volatile principle in mineral waters, is an idea which is now very generally received, and has indeed been clearly aſcertained by ſeveral authors. *(c)* Dr. Brownrigg, a faithful and judicious obſerver, diſcovered above forty years ago, "that there is in ſome mineral waters, a particular kind of air, or permanently elaſtic fluid; that it is this fluid which enters the compoſition of the waters of Pyrmont, Spa, and of all others which,

(b) Eſſays Medic. and Experimental, vol. 3, p. 229.
(c) Page the 7th of this Commentary,

from

from their ſharp and pungent taſte, are called *acidulæ*; and that it conſtitutes the volatile principle of theſe waters, called their ſpirit, on which their prime virtues chiefly depend." *(d)*

The German Spa waters are recommended by Hoffman, in the ſtone, and in ulcers and all painful affections of the urinary paſſages. *(e)* And Henr. ab Heer ſays, that by drinking theſe waters, the *calculi* are voided ſoft and friable. *Molles inde calculi et friables minguntur.* *(f)* The *acidulæ* in general, are extolled not only by Hoffman, but by many of the German writers, as efficacious both in preventing and diſſolving the ſtone.

It would be ſuperfluous to introduce a train of authorities, or to enumerate

(d) Philoſ. Tranſ. for 1765, artic. 26.
(e) Fred. Hoff. Op. Tom. v. p. 146.
(f) Spadacrene, p. 79.

a variety

a variety of theſe waters; I ſhall only mention the *Carolinæ* which are of this claſs, and which abound with Fixed Air. Springsfeld, who wrote on this ſubject in the year 1756, obſerved, that the human *calculus*, by being macerated in theſe waters, was conſiderably diminiſhed; that the *calculus* was likewiſe diminiſhed, by being immerſed in the urine of thoſe who drank the waters; while the urine of a healthy man, who was not drinking theſe or ſimilar waters, added to the bulk of the *calculus*. *Calculum humanum, ſi in his aquis macere-tur, minuunt inſigniter; hoc calculis renum et veſicæ accidit, non tantum in Therma-rum aqua, verum etiam in urina illorum, qui Thermas potabant; cum urina ſani ho-minis, qui has vel ſimiles aquas non potet, calculum immerſum augeat.* (g)

4. Mild and ſound malt liquor is

(g) *De Prærogat. Therm. Carolin. in diſſolvendo cal-culo veſicæ præ aqua calcis vivæ.* Lipſic. 1756.

conſiderably

conſiderably impregnated with Fixed Air, and has been recommended both as a preſervative, and as affording relief to thoſe who are afflicted with the ſtone. Cyprian, a celebrated lithotomiſt, was a very ſanguine advocate in favour of malt liquor. Of fourteen hundred patients, whom he had cut for the ſtone, there was not one whoſe common drink had been malt liquor. I ſhall give the reader the paſſage, as it ſtands in *Allen's Synopſis*, and quoted from *Catherwood*. D. *Cyprianus, lithotomus celeberrimus, inter* 1400, *quibus operationem celebravit*, oinopolas *quam plures, ſed ne unum quidem* zythopolam *calculoſum invenit.* (*b*) There may be ſome foundation for this prejudice of Cyprian, but he muſt certainly be miſtaken, when he recommends malt liquor as ſo univerſal a preſervative.

The attentive and judicious Syden-

(*b*) Synopſis, art. 747.

ham,

ham, who ſuffered much himſelf from the ſtone, is a more guarded and ſatisfactory evidence on this head. "To prevent bloody urine from the ſtone, whenever I am obliged to go very far in my coach on the ſtones (for the longeſt journey in unpaved road does me not the leaſt hurt) I always drink a large draught of ſmall-beer before I ſet out, and another in the way, if I am abroad a conſiderable time; by which means I ſecure myſelf pretty well from bloody urine. A draught of ſmall-beer ſerves me inſtead of a ſupper; and I drink another draught after I am in bed, and about to compoſe myſelf to ſleep, in order to cool the hot and acrid humours lodged in the kidneys, which breed the ſtone." *(i)*

5. After thus enumerating a variety of facts and obſervations in favour of Fixed Air, as a preſervative, a pallia-

(i) Swan's Sydenham, p. 535.

tive, or a ſolvent of the ſtone; I ſhall briefly mention, the reſult of my own experience, concerning the uſe of this fluid in diſeaſes of the urinary paſſages, whether gravel, ſtone, abſceſs, or eroſion. In two caſes of abſceſs in the kidney, accompanied with great pain, hectic, waſting, and diſcharge of *pus*, I have had the pleaſure to obſerve the good effects of Fixed Air, in alleviating the pains, abating the hectic, and forwarding the cure. In ſome few inſtances of eroſion, I have likewiſe experienced the good effects of Fixed Air. In the gravel, I have met with many proofs of its efficacy, and am happy to find my own experience confirmed by the following extract of a letter from Mr. Dawſon, of Sedbergh, to my friend Dr. Haygarth:

"Ben. Weſtley (for whom you formerly preſcribed when afflicted with an iſchuria) is generally much diſtreſſed with

with the gravel, of which he paſſes large quantities, and frequently mixed with blood. It is of a very looſe texture, and eaſily crumbles by preſſing it with the fingers. Water, impregnated with Fixed Air, entirely diſſolved the ſtony part, leaving nothing but a ſoft mucus. Encouraged by this experiment, I made him drink the mephitic water, which relieved him pretty much by the time he had uſed four or five bottles. This method he has tried ſeveral times, and always with the ſame ſucceſs. This is the only inſtance in this complaint, where I have made any trial of it."

With reſpect to the ſtone, I have had very little, and no deciſive experience, of the effects of Fixed Air. It may be aſked, whether any one caſe has yet occurred, in which a ſtone in the bladder has been totally diſſolved by the adminiſtration of this remedy? No ſuch caſe, I apprehend, has hitherto occur-

red. A very flattering one indeed, fell under the care of Dr. Hulme, of the Charter-houſe. In this patient, the ſtone appears to have been of a texture favourable for ſolution, a great number of calculous fragments were evacuated ſoon after he began the uſe of Fixed Air, and he was in a few weeks ſo free from complaints, that the cure was ſuppoſed to have been completed. The old penſioner however is ſince dead, and Dr. Hulme has favoured me with the following ingenuous narrative of the appearances on diſſection.

" It is very true that our Charter-houſe patient is dead. He was ſeized with a total ſuppreſſion of urine, and the obſtruction was ſo great as to prevent the introduction of the catheter, and to elude all other means of relief. On opening the body, the immediate cauſe of the obſtruction was found to be an enlargement of the proſtate-

gland.

gland. All the urinary paſſages were free and open, (except what was cauſed by the preſſure of the proſtate) no *calculus* being found either in the kidneys, ureters, or urethra. When the bladder was opened and expoſed to view, a good many ſmall *calculi* were found of various ſizes, and ſome broken into very ſmall fragments, ſo as to have paſſed the neck of the bladder very eaſily, had there not been an obſtruction from the preſſure of the enlarged proſtate. The large-ſized *calculi* had rough ſurfaces, and various ridges or eminent lines running upon them, ſo that there was not the leaſt evident ſign of their being broken down by trituration, or rubbing againſt each other; as in that caſe I imagined they would have put on a ſmooth ſurface. Hence the appearances of the *calculi*, in this ſubject, rather make in favour of a ſolution having taken place, and been continued, than the contrary. It is alſo pretty clear

clear from the diſſection, that the ſtone was no cauſe of the patient's death. The patient remained perfectly free from all ſymptoms of the ſtone, for many months before his death, which I can hardly tell how to account for, unleſs the enlargement of the proſtate (for ſome preceding months) had cauſed ſuch a ſtrong preſſure round the urethra, as to prevent any calculous fragments from paſſing the neck of the bladder, or entering into the urinary canal: for, as I have ſaid above, there were a great many of them ſo ſmall as to have eaſily paſſed through any urethra in a ſound and open ſtate. From all which circumſtances, I am rather inclined to think, if this patient had lived, and not had a morbid urethra, that the *calculi* would have been gradually evacuated, either in fragments, or in the form of a cretaceous ſediment, and that he would have received a perfect cure."

" Our expectations, adds Dr. Hulme, of the efficacy of Fixed Air, in calculous caſes, may perhaps have been too ſanguine; but as yet the experiments have not certainly been ſufficient to determine the matter: let us not deſpair too ſoon, but purſue the idea for ſome time. Though many *calculi* may be of ſo flinty a nature, or ſo circumſtanced, as not to yield to this kind of remedy, yet it may ſucceed in ſome other caſes; one of which, I think, I have under my care at preſent. This patient had laboured under ſymptoms of the ſtone for ſome years, and had taken various things without ſucceſs. Among other ſymptoms common to this diſeaſe, he had the ſenſation of a large heavy weight in the bladder, which on making a falſe ſtep, &c. gave him much jarring pain; he made but a ſmall quantity of urine at a time, and that with great uneaſineſs. He was ſearched, and a ſtone found. He applied to me, and

I ordered

I ordered him the alkali and acid, to be taken ſeparately, as mentioned in my publication. It had no effect on him for the firſt two or three weeks; he afterwards began to void, every day with his urine, a quantity of brown or whitiſh calculous ſediment, which he has continued to do for ſome months paſt, and ſtill purſues the ſame plan. The ſymptoms are greatly diminiſhed, he can retain his urine much longer, makes it in a larger ſtream, and the ſtone ſits light and eaſy in the bladder, and according to the patient's ſenſation and opinion, is reduced to a ſmall ſize. Whether the medicines will have ſufficient power to act upon the nucleus, or remainder of the ſtone, and bring it entirely away, time alone muſt diſcover."

Upon the whole, the ſedative and ſolvent powers of Fixed Air, in caſes of the ſtone, are ſo far aſcertained, as to give it a claim to the particular attention

tention of the faculty. Further experience can alone determine, whether by the ſteady and long continued uſe of this medicine, a cure may not in ſome inſtances be happily effected: and it is no inconſiderable recommendation, that the medicine is pleaſant, ſafe, and even friendly to the conſtitution; and that it will relieve the painful ſymptoms, though it ſhould not produce a complete ſolution of the *calculus*.

6. With reſpect to the method of adminiſtering Fixed Air in caſes of the Stone, the following I apprehend will be found to be the moſt eaſy and powerful. Let the patient take three times a day, an ounce of the *aqua mephitica alkalina*, containing one ſcruple of alkaline ſalt, ſaturated with Fixed Air according to the directions of Mr. Bewley, *(k)* and ſweetened with a little honey: let him waſh this down with half

(k) Prieſtley on Air, vol. 2d, p. 346.

an ounce or a large ſpoonful of lemon-juice, made into lemonade. The patient thus takes, not only the common proportion of Fixed Air contained in the alkaline ſalt, but likewiſe that which has been ſuperadded to ſaturate or neutralize it. The common drink of the patient ſhould be, mephitic water, *wort* ſweetened with honey provided it ſits eaſy and agrees with the ſtomach, mead, or ſound malt liquor. Caſk-ale I think is preferable to that which is kept in bottles, on this account, the Fixed Air is in a more quieſcent ſtate, is not loſt in eructations from the *primæ viæ*, and is conſequently conveyed in a larger proportion to the kidneys and bladder. Honey may be eaten at pleaſure, as perfectly coinciding with the intentions of the medicine; and where it ſuits the conſtitution, may be uſed to the quantity of a pound or a pound and a quarter every week, as recommended by Sir John Pringle.

By

By this method, the urine will be well impregnated with a conſtant and copious ſupply of Fixed Air; more ſo indeed, than by immediately injecting the mephitic water into the bladder. For the ſupply by injection, would be irregular and inadequate, the operation being attended with ſo much pain and inconvenience, as to prevent its uniform and frequent repetition; and when conveyed into the bladder, the irritation, from ſudden diſtention, would be ſuch, as often to occaſion its being rejected.

Before the patient begins his courſe, it is a good precaution, to examine the ſtony ſediment of the urine, or any calculous fragments which are paſſed, by putting them to the teſt of Fixed Air. This will determine, as Doctor Ambroſe Dawſon judiciouſly obſerves, whether the calculus is of ſuch a nature, as to be ſoluble in the medicine which is propoſed. *(l)*

(l) Medical Tranſactions, vol. 2, p. 119.

Some *calculi* abound ſo much with *mucus*, as to elude the action of Fixed Air. In ſuch caſes, the alternately exhibiting the cauſtic alkali and Fixed Air, as recommended by Dr. Saunders, will facilitate the ſolution.

SECTION IX.

On the diſpoſition to the ſtone in the cyder counties, compared with ſome other parts of England.

Whether the ſtone is a rare or frequent diſeaſe in countries where the general beverage abounds with Fixed Air, is a queſtion which can alone be determined by a faithful narrative of facts. Solicitous to throw further light on a ſubject, in which too many of my fellow creatures are intereſted, and to contribute by every poſſible means, to remove or at leaſt mitigate the pains of this dreadful diſeaſe, I have been at ſome trouble to collect a

comparative

comparative view of the diſpoſition to the ſtone in ſeveral parts of the kingdom. My deſign was, to aſcertain the number of patients who had been cut for the ſtone, in the ſeveral hoſpitals to which I applied, compared with the whole number of both in and out patients; and likewiſe, whether there was any thing peculiar in the food, drink, or ſituation of the inhabitants of the reſpective diſtricts. After returning my ſincere thanks to thoſe gentlemen, who have given me information on theſe heads, I ſhall proceed to lay before the reader the reſult of this inquiry.

§ 1. *Newcaſtle*. The hoſpital here, is for the town of Newcaſtle, and the counties of Durham and Northumberland. Out of 26,619 patients, 93 have been cut for the ſtone; or 1 in 287. "The lower people in general, Mr. Lambert informs me, work hard and live well; in the towns, as the ſame

rank

rank uſually live in towns; their drink, a well-brewed and well-hopped malt liquor, without ſo much tippling in ſpirits as in many other of the ſea-ports. The farmers and labourers live much after the ſame manner as ſuch people do in all the northern counties. As to calculous patients, we have never obſerved more admitted from one diſtrict than another, having been equally received at the hoſpital from all quarters within the limits of its circuit." The water in common uſe at Newcaſtle, is taken from the river Tyne. This water has been accurately examined by Dr. Rotheram, and found to be ſoft and pure. *(m)*

§ 2. *York.* In this hoſpital, 50 have been cut for the ſtone, out of 23,735, or 1 in 474. "The lower claſs of people, ſays Dr. Hunter, drink their malt liquor remarkably new; and as far as

(m) Philoſ. Inq. into the nature and properties of water.

I can learn, the river water running over an ouzy bed, is uſed for all domeſtic purpoſes."

§ 3. *Leeds.* In the Leeds hoſpital, out of 7,851 patients, 23 have been cut, or 1 in 340. Of this number, ſeven came from the townſhip and four from the pariſh of Leeds, the reſt came from a diſtance. The townſhip of Leeds contains above 17,000 inhabitants, and the pariſh is ſuppoſed to contain about the ſame number. Mr. Lucas further obſerves, " that the common drink of the town and neighbourhood, is malt liquor, which is chiefly ſupplied by three common breweries, all of which are ſoft water. The town is ſerved from the river with ſoft water; the ſprings in general afford hard water."

§ 4. *Mancheſter.* Mr. White informs me, that in the Mancheſter hoſpital, 62 patients have been cut for the ſtone, out

out of 34,565, or 1 in 557. Of this number, 12 were from the town of Mancheſter, 8 from Sheffield, 4 from Halifax, 3 from Congleton, 3 from Aſhton, 3 from Wigan, 2 from Derby, 2 from Bolton, 2 from Bury, 2 from Rochdale, 2 from Lancaſter, 1 from Cheſter; and the reſt were country patients, from a circuit of conſiderable extent. It is to be obſerved, that the pump waters of Mancheſter are remarkably hard; *(n)* and yet this town has ſent only 12 ſtone patients to the hoſpital, during a courſe of 26 years; while Sheffield, which Mr. Wooffendale informs me, is wholly ſupplied with very ſoft water from an open reſervoir at ſome diſtance from the town, has in ſix years ſent 8 patients to the Mancheſter hoſpital.

§ 5. *Liverpool.* It appears from the Mancheſter report, that the ſtone is

(n) Percival's Eſſays, vol. 1, p. 344.

not

not a frequent diſeaſe either in the town of Mancheſter or the eaſtern parts of Lancaſhire; and I know from the experience and obſervations of twenty years, that it is ſtill a much leſs frequent diſeaſe in Liverpool and the weſtern parts of Lancaſhire. Of 26,073 hoſpital patients at Liverpool, only ſix have been cut for the ſtone; or 1 in 4,345. The common drink of the lower people in this county, is water, milk and water, butter-milk, ſmall-beer, or ale. The ſpring water of Liverpool, which is for table uſe, is tolerably pure; and the ſprings through the county in general, are often hard.

§ 6. *Cheſter.* Dr. Haygarth has favoured me with the following information concerning Cheſter, and its neighbourhood. "Both from my own obſervation and very extenſive inquiries among the medical practitioners, it appears, that the *calculus veſicæ* is a very

uncommon diſeaſe in North Wales. In the whole diſtrict, for the laſt twelve years, I cannot learn that more than one patient has been cut, and that ſix, ſuppoſed to be afflicted with the ſtone, have died without ſubmitting to the operation. In Cheſhire, my medical connections and inquiries, comprehend the weſtern half of the county; in which I have been informed, that in the courſe of the laſt twelve years, five have been cut, and two have died uncut.

"The Cheſter infirmary is the receptacle of the diſeaſed poor from the diſtricts above deſcribed. Of 12,334 in and out patients, admitted ſince its eſtabliſhment, only one has been cut for the ſtone; nor can I learn that another calculous caſe ever offered, though in this inſtance the operation was performed ſucceſsfully, and though our ſurgeons are juſtly celebrated for their ſkill and dexterity." If to the patient here mentioned, be added another

ther Cheſter patient who was cut at the Mancheſter hoſpital in the year 1763, before Dr. Haygarth was fixed at Cheſter, the proportion will be 2 in 12,334, or 1 in 6,167.

" At Cheſter, continues Dr. Haygarth, the very loweſt claſs of people, drink a kind of fermented liquor. At our ſugar-houſes, the molds in which the ſugar is refined, are immerſed in water, to diſſolve what adheres to them, after the loaf is taken out. The water having ſerved this purpoſe for a week, is impregnated with ſugar, and ſold under the denomination of *ſweet water*, at the rate of ſix gallons for a penny; ſo that the very pooreſt may purchaſe it. This liquor fermented with yeſt, is drank as ſmall-beer; and 844 gallons are conſumed every week. It is not ſo pleaſant however, but that many prefer milk or even water.

" Both in North Wales and Cheſhire,

the loweſt claſs univerſally drink water or milk, chiefly butter-milk. But the farmers of all denominations have malt liquor in their houſes, generally ale. All claſſes, both in town and country, get ale occaſionally at the public-houſes. Tea, which renders water more diuretic, is drank every where.---I know of no liquor, that ſo manifeſtly occaſions nephritic ſymptoms, as old ſtale ſtrong beer.

" Cheſter is ſo plentifully ſupplied with water from the Dee, that river water is moſt generally uſed for domeſtic purpoſes by all the inhabitants; however both ſpring and pump water are occaſionally drank. I have evaporated to drineſs, by a gentle heat, not exceeding 100°, theſe different kinds of water; and found in a gallon of the Dee water, a *reſiduum* of 7 grains; of a favourite ſpring, called Barrel-well, 15 grains;

grains; and of each of the other ſprings, from 60 to 80 grains."

§ 7. *Shrewſbury.* In the hoſpital here, 8 patients have been cut for the ſtone, out of 13,167, or 1 in 1,646. "Cyder, Dr. Owen informs me, is but little uſed among the inferior mechanics and peaſants of this country. The very ſmall quantity they conſume, is miſerable, crude, auſtere ſtuff, the produce of our own county, but too inconſiderable in quantity to be admitted as the ground of any concluſion, reſpecting its power of generating calculous concretions. Their beverage is almoſt entirely ſmall-beer or ale. Their bread is compoſed chiefly of a certain proportion of wheat and rye, which is light and well fermented; and they live well on a due proportion of animal and vegetable food. On the whole, you will conclude, that I can draw no practical inference reſpecting the occaſional cauſe of the ſtone in this part of the kingdom."

Of

Of the 8 patients mentioned by Dr. Owen, 1 was from the town of Shrewſbury, 4 from the county of Salop, 2 from Staffordſhire, and 1 from the county of Montgomery.

§ 8. *Leiceſter.* "Our infirmary, ſays Dr. Vaughan, was opened in the year 1771, ſince which time 1,912 perſons have been admitted in and out patients. Of this number, three only have undergone the operation of lithotomy; and one man, who died of a chronic diſeaſe, without any ſymptom of a ſtone during his life time, was found to have one after his death, of the weight of two ounces, and the ſurface of it very rugged. I am not acquainted with any particular diſtrict, where the inhabitants are more than uſually afflicted with the diſeaſe; nor am I aware that any particular kind of diet has contributed to the formation of ſo terrible a malady: but let me at the ſame time acknowledge,

knowledge, I have not in this reſpect paid particular attention."

Of 1,912 patients therefore in the Leiceſter infirmary, 4 have been afflicted with the ſtone, or 1 in 478.

§ 9. *Glouceſter*. From the firſt inſtitution of this hoſpital, in the year 1755, 21 patients have been cut for the ſtone, out of 12,490, or 1 in 594. Mr. Cheſton has favoured me with the following information. "Since Nov. 1771, I have cut eleven patients in our hoſpital for the ſtone, eight of whom have been of different ages, from 4 to 12, one about 17, another 19, and a third about 25. But not one of theſe could I am ſure, from their ſituation, as well as the parts of the county they came from, have ever been in the way of drinking cyder for their common liquor. My colleague, Mr. Crump, has cut two who may be conſidered in the ſame light.

From

" From a particular review of the pariſhes in the neighbourhood of this city, where there is the largeſt growth of apples or pears, the *true calculus* is certainly an uncommon diſeaſe; for tho' the ſtone and gravel, as it is commonly called, may be frequently complained of by many people, it is in too indiſcriminate a manner to be worth attention; and the real cauſe of ſuch complaints almoſt always proceeds from an indiſpoſition of the bladder, or that diſcharge of ſmall ſandy particles, which rarely are concreted together of any ſize, and conſequently not the object of your enquiry.

" Within a few miles of this city are made different ſorts of perry; one of which, from the common ſuffrages of the people, is reckoned particularly ſerviceable in the gravel. The fruit it is made from, bears the name of Barland-pears, and the juice is certainly very diuretic,

diuretic, of an auſtere aſtringent taſte, and very inebriating. Whether its effects may be attributed to any peculiarly ſtimulating quality, or to the large portion of Fixed Air it may contain, is not in my power at preſent to determine."

In a ſubſequent letter, Mr. Cheſton further obſerves, that " The drink of the common people in the cyder counties is in general a weak cyder, made by adding water to the cakes of the apples, after the prime juice has been extracted from them. This mixture is again ground, and committed to the preſs a ſecond time; and having afterwards undergone a conſiderable degree of fermentation, is frequently made uſe of in a fortnight or three weeks after it has been in the caſk, when it drinks briſk, and will at firſt ſparkle in the glaſs, but if kept any time becomes vapid, harſh, and at laſt ſour.

" In the farm houſes moſt of the cyder drank by the family in the early part of the ſeaſon, is of this kind; and when this is exhauſted they proceed to the liquor made from the inferior fruits, which is leſs diluted for the purpoſe of keeping the better. It is however impoſſible to determine, with any degree of certainty, the quality of theſe different liquors, as the ſtate of the fruit when ground, the plentifulneſs of the ſeaſon, and the attention to the fermentation afterwards, ever make a variation in the quality, and of courſe in the effect, of this beverage. But no doubt can be made that they contain a conſiderable portion of Fixed Air, which they do not readily part with, if the fermentation in the caſk is not ſuffered to proceed ſo far as to become acetous. This is prevented by repeated rackings.

" Being anxious for the reaſons aſ-

ſigned

ſigned in my laſt to extend my inquiries, particularly to the Barland perry, I with ſome difficulty got different ſpecimens of it; but found that, like other perry, it was very prone to fermentation, and therefore contained more or leſs Fixed Air in proportion as this circumſtance, by proper care, had been regulated and conquered. In no other reſpect but the auſtere taſte, did it ſeem eſſentially to differ from other perry."

Mr. Cheſton concludes with the following pertinent query: "Does not the difference in the number cut at the different hoſpitals, in your narrative, depend more on the character of the ſurgeons, or their inclination for the operation, than any provincial cauſe? At a county hoſpital, which has been eſtabliſhed ſome years, I have been aſſured, no ſtone patient was cut till lately; all that offered being recommended to London." The circumſtance

here pointed out, has been particularly attended to through the whole of this inquiry.

§ 10. *Worceſter*. During the laſt twelve years, 25 patients have been cut in this hoſpital, out of 7,752, or 1 in 310. Of this number, ſixteen were cut by Mr. Ruſſell, and nine fell under the care of the other ſurgeons. "I do not recollect, ſays Mr. Ruſſell, that any one of thoſe cut here, came out of Herefordſhire, and believe the diſeaſe is leſs frequent there, than in this or the neighbouring counties. It is however rather a vulgar error, which has pretty generally prevailed, to ſuppoſe that cyder drinkers never have the ſtone in the bladder. A few years ago I was called to a man, aged 68, who during his whole life ſcarcely ever taſted any other liquor than cyder; but upon paſſing a ſound into his bladder, I found a *very large* ſtone indeed. I know a farmer,

mer, a few miles from Worceſter, upwards of ſeventy, who from his childhood till lately has drank chiefly cyder and perry for his common drink. He finds rather leſs pain when he drinks freſh malt liquor; and he has a conſiderable ſtone or ſtones in his bladder.

" In conſequence of Dr. Hulme's firſt publication, I have ever ſince recommended to my nephritic patients the ſal. tartar and ſpirit. vitriol. ten. agreeable to his directions; and I think moſt, nay all of them (which have not been a few) have at leaſt for a while, found an abatement of their pain. Some have perſiſted in taking it conſtantly for many weeks, others only from time to time, but not one has received a cure, nor has it appeared by the urine that there was the leaſt reaſon to hope a diſſolution of any part of the ſtone had taken place. In Herefordſhire, I believe

lieve nephritic complaints are leſs frequent than in this county."

§ 11. *Hereford.* The hoſpital here, Dr. Cam informs me, "is a temporary building of not three years ſtanding, and makes only 25 beds. The number of in and out patients does not exceed 798, and I do not find one who has been afflicted with the ſtone."

§ 12. *Exeter.* In the Devon and Exeter hoſpital, 75 patients have been cut, out of 26,606, or 1 in 355. "I ſhall with pleaſure, ſays Dr. Glaſs, give you the beſt intelligence I can, with reſpect to the fact you wiſh to have aſcertained. In the county of Devon, the ſtone and gravel are common diſeaſes among the lower claſſes of people; but whether our people are more or leſs ſubject to theſe diſeaſes, than the inhabitants of other counties who drink no cyder, I cannot pretend to ſay. It was you know

know Sydenham's opinion, that ſmall-beer drank plentifully, prevented the growth of the ſtone in the kidneys; and I imagine there is more Fixed Air in beer than cyder, at the end of fermentation."

If we take the medium of the reports of the Glouceſter, Worceſter, Hereford, and Exeter hoſpitals, a circle in which more cyder is drank than in any other part of the kingdom, and which may therefore properly be called the cyder diſtrict, the proportion of thoſe who have been cut for the ſtone, to the whole number of patients from all other diſeaſes, is 121 in 47,646, or 1 in 394.

I ſhall only mention the reports of two other counties, on the ſouth-eaſt or oppoſite ſide of the kingdom; the two adjoining counties of Cambridge and Norfolk.

13. *Cambridge.*

§ 13. *Cambridge.* "Out of 6,600 in and out patients, ſays Dr. Collignon, admitted on our books, only four have been cut for the ſtone, or 1 in 1,650. Malt liquor is the entire liquor of our poor, and except in the heat of the harveſt months, the ſmall-beer is generally very new. The water in this place and neighbourhood is not any ways remarkable for hardneſs or ſoftneſs, compared I mean with many others; though the incruſting tea-kettles, turning greeniſh when poured on violets, and becoming turbid with a ſolution of *ſaccharum ſaturni*, are impeachments of its purity."

§ 14. *Norwich.* In the Norwich and Norfolk hoſpital, 55 have been cut, out of 3,016, or 1 in 55. An aſtoniſhingly great proportion indeed.---I learn from Dr. Manning, that 17 of the above 55 ſtone patients belonged to the town of Norwich. "The pump water, ſays

ſays the Doctor, in general uſe here for drinking, &c. does not lather with ſoap, but is hard, and conſiderably incruſts tea-kettles. The river water, which is in common culinary uſe, is ſoft and lathers eaſily with ſoap. I know of no particular diſtrict, which has furniſhed more than its proportion of ſtone patients; nor of any particularity in the diet or drink of ſuch as have been admitted into the hoſpital. The bread of Norfolk is wheat; and the beverage beer, generally new and often acid. There is not much to be expected from the hiſtory of different diſtricts in Norfolk. The baſis of our county is chalk, and the ſurface a flint ſand or gravel, mixed with a ſmall portion of clay and tinged with ochre. The moſt *ſtupendous* of our *mountains* may be 40 or 50 feet high."

General Obſervations and Queries.

I. It appears that the ſtone in the

bladder is not an uncommon diſeaſe among the lower claſs of people in the cyder diſtrict; more common indeed, than in ſeveral other parts of the kingdom, in which malt-liquor is the general beverage. It has already been obſerved, that the number of ſtone patients cut in the reſpective hoſpitals, may vary, according to the celebrity of the operators or the inclination to operate. This objection however loſes the greateſt part of its weight, by taking the *medium* report of a number of hoſpitals, and in a wide extended circle. In the Glouceſter, Worceſter, Hereford, and Exeter hoſpitals, 121 patients have been cut for the ſtone, out of 47,646, or 1 in 394. The report of the North Eaſt part of England, including the hoſpitals of Newcaſtle, York, Leeds, and Mancheſter, ſhows that 228 have been cut, out of 95,770 patients, or 1 in 420. The report of the North Weſt part of England, comprehending the

hoſpitals

hoſpitals of Liverpool, Cheſter, Shrewſbury, and the whole of North Wales, mentions 16 patients who have undergone the operation, out of 51,574, or 1 in 3,223. The ſtone therefore is a more common diſeaſe in the cyder diſtrict, than in North Wales and the North of England.

II. This inquiry confirms the general opinion, that thoſe liquors which are hard and contain a crude acid, are prejudicial to conſtitutions which have a diſpoſition to the ſtone. The cyder drank by the poorer people, as remarked by Mr. Cheſton, is weak, contains little Fixed Air, but a large proportion of crude acid, the product of a partial acetous fermentation. *(o)* The report likewiſe of the Norwich and Norfolk hoſpital, gives by far the greateſt number of ſtone patients; and Doctor Manning obſerves, that the beer is ge-

(o) Page 161 of this Commentary.

nerally new and often acid. *(p)* This cauſe alone, however, does not appear adequate to the effect; further experience and obſervation therefore muſt determine, whether this remarkable prevalence of the ſtone in the county of Norfolk, be uniform, how far it is to be attributed to the drink in common uſe, or what other cauſes may concur.

III. Taking in the whole of the preceding reports, it appears probable, that hard waters rather prevent than contribute to the formation of the ſtone. This concluſion is alſo confirmed by the obſervations of practical writers, who have recommended the waters of Buxton, Matlock, Bath, Briſtol, and a number of other hard waters, containing a conſiderable proportion of earth, to patients afflicted with the ſtone and gravel. To this general obſervation, however, of the utility of hard waters

(p) Page 169 of this Commentary.

in

in calculous conſtitutions, ſome exceptions may occur, and in theſe caſes, ſtrict attention is to be paid to peculiarity of conſtitution.

IV. The ſtone is a diſeaſe which prevails much more in certain diſtricts than in others. This is evident from recurring to the particulars of obſervation Iſt, and from comparing the reports of the two counties of Norfolk and Cambridge. *(q)* It is likewiſe to be obſerved, that the great diſproportion in the diſpoſition to the ſtone, not only in ſeparate hoſpitals, but in whole diſtricts, cannot ſatisfactorily be accounted for, by any external circumſtances hitherto diſcovered, reſpecting either food, drink or ſituation.

V. Are we not hence led to conſider the ſtone ſometimes as a diſeaſe of the conſtitution? Is it not in ſome inſtances

(q) Page 168 of this Commentary.

rather

rather an animal production, than proceeding from ſtony matter introduced *ab extra*, and afterwards collected and concreted in the kidneys or bladder? And is not this idea confirmed, by the following arguments from analogy?

1. If the animal earth be ſupplied *ab extra*, and conveyed into the ſyſtem with the food or drink in the form of earth, it ought to be found of the ſame nature in whatever part of the body it is detected. We learn however from the experiments of a juſtly celebrated chemiſt, Dr. Lewis, that the animal earth is different according to the different parts of the animal from which it is obtained, and alſo according to the difference of *mode* by which it is obtained. The earth of the *ſhells of ſea-fiſhes*, is by calcination changed into quick-lime; and is of the ſame nature with chalk, and the mineral calcareous earths: is readily ſoluble in the nitrous, marine,

and

and vegetable acids, but very inconſiderably in the vitriolic. The earth of *bones* and *horns* procured by fire, is ſoluble in the nitrous, marine, and vegetable acids, but not in the vitriolic; it is not convertible into quick-lime, for however ſtrongly calcined, it remains inſipid, and gives no manifeſt impregnation to water. The earth of *blood*, *ſkin*, and *fleſh*, obtained in the ſame manner, is ſoluble in the vitriolic as well as the other acids, and is not convertible into quick-lime. The earth again into which animal ſubſtances are reſolved by putrefaction, is one and the ſame from whatever ſubject it be procured; and does not ſenſibly differ from vegetable mould. *(r)* The animal earth therefore is leſs elementary than is commonly imagined, and receives its different characters from the various combinations and new modifications

(r) Neumann's Chem. tranſlated by Lewis, p. 493, n. 1, 2 and 3.

which

which it undergoes in the animal œconomy. "We have no where, ſays an excellent philoſopher, more ſtriking examples of the converſion of matter into new forms, than in the bodies of animals; changes effected by a natural proceſs, which art has attempted in vain to imitate or account for." (*f*)

2. The earth which is introduced *ab extra*, by drinking mineral waters or by any other means, is not found either to aggravate calculous complaints, or to encreaſe the diſpoſition to the ſtone.

3. The ſhells of fiſhes ſuggeſt an analogy in ſupport of this doctrine. The oyſter, for inſtance, furniſhes by its own peculiar œconomy a large maſs of calcareous earth, which ſerves it for a ſubſtantial covering and defence. This maſs can with no propriety be ſuppoſed to be conveyed into the ſtomach in the

(*f*) Neumann, ibid. page 481.

form

form of earth; or that it could thence be tranſmitted to the ſurface of the oyſter, and there form its ſhell. It appears evidently to be the product of a peculiar organization: and it is a further confirmation of this reaſoning, that in ſome ſhell-fiſh this organic power is exerted only at particular ſeaſons.

4. Another analogy may be deduced from the ſtony matter which incruſts the teeth of the human ſpecies themſelves. This may be concluded to be a conſtitutional diſpoſition, becauſe among a number of perſons whoſe mode of life is the ſame, ſome have their teeth almoſt wholly covered with this ſtony concrete, the ſyſtem producing it in aſtoniſhing quantities, while others are comparatively free.

VI. If the ſtone is to be conſidered in ſome inſtances as an animal production, or as a diſeaſe of the conſtitution,

may we not thence infer, that it is alſo frequently hereditary? Is not this one reaſon why the ſtone is ſo much more prevalent in ſome diſtricts than others, and in which there are no external circumſtances either in ſituation or manner of life, by which we can account for the greater or leſs frequency of the diſeaſe?

Such are my preſent thoughts on this ſubject. I am far, however, from conſidering them as clear and concluſive. Other phyſicians may make different comments, and draw different inferences from the above reports; and a ſtill more extenſive collection of facts may produce alſo a more uſeful, ſatisfactory, and deciſive theory.

I cannot conclude this ſection, without expreſſing a wiſh, that the hoſpital reports throughout the kingdom, were drawn up in a more full and circumſtantial

ſtantial manner. The ſources and nature of endemics, and of ſome other diſeaſes alſo with which we are at preſent but obſcurely acquainted, might be thus more clearly aſcertained, and a more ſucceſsful method of cure conſequently adopted.

SECTION X.

On the noxious effects of Fixed Air.

In a paper which was written ſome years ago on the *noxious vapours of charcoal*, and publiſhed at the requeſt of my friend Dr. Percival, in the ſecond volume of his *Eſſays Medical and Experimental*, I endeavoured to point out, that thoſe animals which are killed in the Grotto di Cani, in the cavern of Pyrmont, *(t)* or by the vapours of burning charcoal,

(t) To which I may now add the caverns of Schwalbach.---The vapour in all theſe places, conſiſts principally, if not entirely, of Fixed Air. That in the caverns of Schwalbach poſſeſſes the known properties of Fixed Air; it preſerves animal ſubſtances from putrefaction, and immediately kills all the inſects, reptiles, or other animals which it ſurrounds: *et quod notabile admodum,*

charcoal, are not ſuffocated, according to the opinion of Hoffman, Hales, and Morgagni, but that the vital principle itſelf is immediately extinguiſhed by the action of theſe vapours on the brain and nervous ſyſtem. It appears likewiſe that the various kinds of Fixed or Factitious Air, act in a ſimilar manner, when ſo applied as to occaſion death.

Suffocation, or the taking away life by a ſtoppage of reſpiration, is not an inſtantaneous but a gradual proceſs. Whereas in thoſe animals which are killed by being immerſed in Fixed Air, death is immediate and without ſtruggle. Even flies and other inſects, which have

modum, quouſque effluvia in aere diffunduntur, muſcus, mures, glires, ſerpentes, bufones, cæcilias, lacertas, vermes, nullatenus ſubſiſtere poſſe. See p. 88 of this Commentary, *et Merian. Topograph.* p. 123 & 127. The waters themſelves are likewiſe ſo ſtrongly impregnated with this vapour, as to kill frogs and fiſhes of every kind: *ranas nimirum, cancros, piſces quoſcunque, in his aquis incontinenter mori. ibid.* Hence we ſee the probable utility of Fixed Air in worm caſes, as recommended by Dr. Hulme.

have no lungs, and conſequently cannot ſuffer by ſuffocation, inſtantly drop down motionleſs. The effects here are the ſame with thoſe which are produced by lightning or the electrical ſhock.

Dr. Hales indeed ſays, that lightning kills by ſuffocation, diminiſhing the elaſticity of the air, and making the veſicles of the lungs to collapſe ſo as to cauſe ſudden death. *(u)* But the appearances in thoſe animals which are killed either by lightning or electricity, do not in the leaſt reſemble thoſe which are obſerved in animals killed under an exhauſted receiver. An ingenious lecturer on natural philoſophy, propoſed to ſhow his pupils what ſtrength of an electrical ſhock would kill a pigeon. The diſcharge was accordingly made: when, to their great ſurpriſe, the bird continued in the ſame attitude, and appeared not to have ſuffered the leaſt in-

(u) Statical Eſſays, vol. 1, p. 261.

jury.

jury. The lecturer therefore ſuppoſed, that by ſome accident the bird had eſcaped the ſhock, and was preparing to diſcharge another phial. A gentleman however in the mean time putting his hand on the pigeon found it already dead, without any change either in the eyes, the attitude, or the ruffling of a ſingle feather. Lightning is not leſs inſtantaneous in its fatal effects than electricity; and when the celebrated profeſſor Richman fell a ſacrifice to his philoſophical curioſity, and was killed by a flaſh of lightning conducted by his *apparatus* from the clouds, his diſſolution was inſtantaneous, and he felt no more pain than if he had fallen aſleep.

Equally inſtantaneous are the deſtructive effects of Fixed Air; and where an animal is expoſed to it even in a more dilute tho' yet noxious ſtate, the miſchief is ſtill exerted on the brain and nervous

nervous ſyſtem, producing a gradual and inſenſible extinction of the vital principle. Of this I have met with a number of inſtances, but ſhall relate only the two following.

Lime kilns throw off large quantities of Fixed Air, and thoſe who incautiouſly lay themſelves down either on the walls of the kiln, or ſo near as to be expoſed to the vapour which riſes from the burning lime ſtone, often experience its pernicious effects. Some years ago, I remember a poor family of this town, which lodged in a room adjoining to a lime kiln; during the night, the vapour of the burning lime made its way into the room, and the four perſons of which the family conſiſted, were all killed. In the morning they were found lying as in a compoſed ſleep, without any appearance of having gone thro' either pain or ſtruggle.

In the Spring of this year, 1778, two diſorderly young women, after rambling about the town for a conſiderable part of the night, crept early in the morning into a little hovel which was contiguous to a lime kiln. The kiln was charged and burning, and the vapour of the lime was forced thro' ſome crevices into the hovel. After ſome hours, the man who had the care of the kiln, and who was father to one of the women, came to look after his work, and finding them as he ſuppoſed aſleep, went away without diſturbing them; ſome time after he returned, and ſeeing them ſtill in the ſame place, endeavoured to awaken them, but in vain; they were cold and motionleſs. In one there did not appear to be the leaſt remains of life; and in the other there was only a ſlight and indiſtinct movement about the heart. This patient was ſoon conveyed to the hoſpital, and by fomentations applied to the whole body, friction

tion

tion, veneſection, bliſtering, and, as ſoon as ſhe could ſwallow, ſome doſes of emetic tartar, ſhe perfectly recovered. The other was not conveyed to the hoſpital ſo early, the ſame means were uſed, but without ſucceſs.

When the patient who recovered, was firſt brought to the hoſpital, life was only not departed, and the little which remained, was haſtening away without the ſlighteſt appearance of ſenſibility. But the return of life, was accompanied with a very painful ſtruggle. She became uneaſy, reſtleſs, and groaned heavily; ſhe was very hot, the pulſe very rapid, and as ſoon as ſhe could ſpeak, complained much of her head. Within 48 hours, however, of her being brought, ſhe was ſo well recovered as to run away from the hoſpital, without expreſſing the leaſt ſenſe of gratitude for the care and humanity which had been exerciſed towards her.

The melancholy cataſtrophe of the elder Pliny, appears to be another inſtance of the ſame kind. 'Tis well known, that this diſtinguiſhed and inquiſitive philoſopher was deprived of life, by approaching too near Mount Veſuvius, during one of its moſt tremendous eruptions. The general ſuppoſition is, that he was burnt or ſuffocated; but it is more probable, that life was immediately extinguiſhed, by the breaking forth of a mephitic vapour. The account is related at large by his nephew, the conſul; from which I ſhall tranſcribe the following extract. "*Ibi ſuper abjectum linteum recubans, ſemel atque iterum frigidam poposcit, hauſitque: deinde flammæ, flammarumque prænuntius odor ſulfuris, alios in fugam vertunt, excitant illum. Innixus ſervis duobus aſſurrexit, & ſtatim concidit, ut ego colligo, craſſiore caligine ſpiritu obſtructo, clauſoque ſtomacho, qui illi natura invalidus & anguſtus & frequenter intræſtuans erat. Ubi dies redditur, is ab*

eo,

eo, quem noviſſimè viderat, tertius, corpus inventum eſt integrum, illæſum, opertumque, ut fuerat indutus: habitus corporis quieſcenti quàm defuncto ſimilior." (x)

I ſhall likewiſe give the reader the above paſſage, in the words of our Engliſh Pliny, Mr. Melmoth. " There my uncle having drank a draught or two of cold water, threw himſelf down upon a cloth which was ſpread for him, when immediately the flames, and a ſtrong ſmell of ſulphur, which was the forerunner of them, diſperſed the reſt of the company, and obliged him to riſe. He raiſed himſelf up with the aſſiſtance of two of his ſervants, and inſtantly fell down dead; ſuffocated, as I conjecture, by ſome groſs and noxious vapour, having always had weak lungs, and frequently ſubject to a difficulty of breathing. As ſoon as it was light again, which was not till the third day

(x) *Plini. Epiſt.* lib. vi. epiſt. 16, ſub finem.

after this melancholy accident, his body was found entire, and without any marks of violence upon it, exactly in the ſame poſture that he fell, and looking more like a man aſleep than dead." *(y)*

The circumſtances which render it probable, that Pliny was killed by a mephitic vapour and not by fire, are the following. The Grotto di Cani, and other places of the ſame nature, ſhow, that theſe vapours abound in the neighbourhood of Veſuvius; and they muſt often, during an eruption, be forced in unuſual quantities from the bowels of the earth, by the heavings and convulſive throws of the mountain. Theſe vapours alſo are heavier than common air, and reſt therefore immediately on the ground; and as Pliny was in a recumbent poſture, he would be much more expoſed to their

(y) The Letters of Pliny, tranſlated by Melmoth.

action

action than his companions and attendants. And laſtly, the appearance of the body after death, was not that of a perſon who had been burnt or ſuffocated by a ſulphureous flame; for he lay like one in whom life had been extinguiſhed without pain or ſtruggle. "*His body was found entire, and without any marks of violence upon it, exactly in the ſame poſture that he fell, and looking more like a man aſleep than dead.*"

Had the attendants of Pliny reſolutely carried the body to a little diſtance, and not left it involved with the poiſonous vapour, his life might have been preſerved. For thoſe animals, which are become motionleſs, and to appearance dead, by being put in the Grotto di Cani, or cavern of Pyrmont, recover, on being withdrawn and placed in the free and open air.

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ERRATA.

PAGE 128, Omitted the reference *(y)* viz. *Praxis medica.* lib. 9. *cap.* 7. *et obſervationum centuria prima, obſerv.* 15.

P. 180, l. 1, of the note, for *muſcus* read *muſcat.*

P. 184, l. 1, for *this* read *the.*