

An essay on the virtues of lime-water in the cure of the stone / By Robert Whytt. With an appendix, containing the case of the Honourable Horatio Walpole, esquire, written by himself.

Contributors

Whytt, Robert, 1714-1766

Walpole, Horatio Walpole, Baron, 1678-1757

Publication/Creation

Edinburgh : Printed by Hamilton, Balfour, and Neill, M,DCC,LII [1752]

Persistent URL

<https://wellcomecollection.org/works/j5jmhh7g>

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A N
E S S A Y

ON THE
Virtues of LIME-WATER

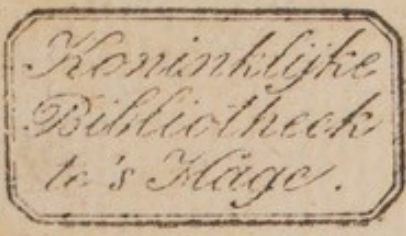
IN THE
CURE of the STONE.

By ROBERT WHYTT, M.D. F.R.S.
FELLOW of the ROYAL COLLEGE of Physicians,
and PROFESSOR of MEDICINE in the University
of EDINBURGH.

Non fingendum aut excogitandum, sed inveniendum. BACON.

With an APPENDIX, containing the Case
of the Honourable HORATIO WALPOLE,
Esquire, written by himself.

EDINBURGH:
Printed by HAMILTON, BALFOUR, and NEILL.
M,DCC,LII.



E S S A Y

IN THE

WORKS OF JAMES WATTS

IN THE

ART OF STEAM ENGINES

BY STEPHEN HUTTON, ESQ.

Author of the History of the Steam Engine, &c.

LONDON: Printed by R. DODD, in Pall-mall.

1781.

Price 10s.



To
HIS GRACE
ARCHIBALD DUKE of *ARGYLL*,
&c. &c. &c.

The following Essay
is inscribed,
With the greatest Respect,

By
HIS GRACE'S
Most devoted, and
most obedient
humble Servant,

ROBERT WHYTT.

To

His Grace

ARCHBISHOP & DUKE OF ANGLIA

&c. &c. &c.

The following Essay

is inscribed

With the greatest Respect

By

His Grace's

Most devoted and

affectionate

Disciple

ROBERT WHITE

ADVERTISEMENT.

THE following Essay was first published in the Year 1743, in the Edinburgh Medical Essays, Vol. 5. Part 2. and met with a more favourable Reception from the Publick, than the Author, considering its Imperfections, had any Reason to expect. It is now printed by itself, at the Desire of several of his Friends, who assured him, that, in this Way, it might be of more general Use, since many Persons, afflicted with the Stone, would chuse to read it, who did not incline to purchase so large a Book as the Medical Essays: And the Author, to render it less unworthy of the Favour of the Publick, has not only corrected, but greatly enlarged it.

The principal Additions are to be found in Sect. ii. iii. ix. x. xi. xii. and
xiii.

xiii. and relate chiefly to—the Nature of Quick-lime and its Water ;— the Strengths and specifick Gravities of different Lime-waters ;—the particular Action of Lime-water in dissolving the Stone,—and to the Cure of the Stone, not only by swallowing Soap and Lime-water, but by injecting the latter into the Bladder.

The Appendix contains the Case of the Honourable HORATIO WALPOLE Esq; written by himself, and given me, at his Desire, by the Honourable Mr. Baron Edlin, of his Majesty's Court of Exchequer in Scotland, with Liberty to make it publick.

I might have added many other Histories of the good Effects of Lime-water in the Stone, had I not been unwilling to swell this Essay to too great a Bulk : And, indeed, I thought this the less needful, as the Usefulness of this
Remedy

Remedy is, within these few Years, become pretty well known in South as well as North Britain. I have chosen, however, to insert Mr. WALPOLE'S Case preferably to any other, not only because the good Effects of the Medicines were here very remarkable, but as it is written by himself, and as the Histories of those, in conspicuous Stations of Life, are wont to make the strongest Impressions upon the Generality of Mankind.

If this Essay, with these Improvements, and as it is now published, shall become of more general Use, and serve to relieve any of his Brethren of Mankind from the racking Pains of the Stone or Gravel, the Author will think his Time and Labour abundantly rewarded.

August 1. 1752.

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ERRATA.

- Pag. 15. lin. ult. for *Kilpatrick* read *Kirkpatrick*.
 Pag. 18. l. ult. after *Etmuller*, add, oper. vol. 1. p. 799.
 Pag. 23. l. 19. for *Geoffroy* read *Morand*.
 Pag. 44. l. ult. after *reperitur*, add, Plin. Histor.
 Natural. lib. 17. cap. 8.
 Pag. 72. l. 18. for *shown* read *shewn*.
 Pag. 92. l. 9. *dele* if.
 Pag. 112. l. 14. for *abound* read *abounds*.
 Pag. 148. l. 29. for *11* read *9*.
 Pag. 150. l. 29. for *474* read *174*.

ESSAY

CONFIDENTIAL

January 1951

MEMORANDUM FOR THE DIRECTOR

Subject: [Illegible]

Reference is made to [Illegible]

RESULTS

The results of the [Illegible]

are summarized in the [Illegible]

attached report [Illegible]

It is recommended that [Illegible]

the [Illegible]

be [Illegible]

for [Illegible]

approval [Illegible]

Very truly yours,

[Illegible Signature]

E S S A Y
ON THE
VIRTUES of LIME-WATER
IN THE
CURE of the STONE.

IN the Year 1739, the Parliament of *Great Britain*, in consequence of a Petition presented to the House of Commons by Mrs. *Joanna Stephens*, generously ordered her a Reward of *L. 5000 Sterling*, for publishing her Medicines against the Stone, in case, upon due Trial, their Utility, Efficacy, and dissolving Power, should be attested by the Trustees named for that Purpose. But altho' the Virtue of these Medicines is such as may justify the Certificate given of them; yet they are so bulky and nauseous, that some People cannot take them, and many use them with the utmost Reluctance; nay, (as the learned *Dr. Jurin* has well observed), so great is the Resolution required to go through a Course of these Medicines,

A cines,

cines, and so many are the Difficulties attending it, that there have been not a few Instances of such as, after taking them for many Months without any Benefit, have submitted to be cut, rather than go on any longer with a Medicine so extremely nauseous, and which had greatly increased their Pains, without bringing any thing away (a).

Dr. *Hartley* (b) leaving out the superfluous useless Part of her Compositions, has reduced them to two and a half Ounces of Soap, and seven and a half Scruples of Egg-shell Powder, as the mean Dose to be taken every Day. But the Powder is so nauseous, and this Quantity of Soap is so great, that I suspect we shall find few Patients who will continue to take the Medicines thus reformed by him for any considerable Time. (c).

After

(a) Dr. *Jurin's* Case, p. 4. and 5.

(b) See his Supplement to the View of the present Evidence.

(c) Dr. *Hartley* has lately, for such as can't take the Soap and Powder in a Liquid, published the following Method of giving them in a solid Form, viz. To take of *Alicant* Soap eight Ounces; powdered Quick-lime a little flaked, one Ounce; Salt of Tartar, or purified Potash, a Dram; and shaving the Soap, and mixing it with the Lime and Salt, to beat all into a soft Mass, with the Help of as much

After reading the ingenious Experiments published (1741) by the Reverend and learned Dr. *Hales*, upon Mrs. *Stephens's* Medicines, I was led to think that Lime-water had as fair a Chance as any thing to dissolve the Stone. For since it there appears, that the Soap owes its Virtues neither to the Potash nor Oil, but wholly to the Quick-lime that enters into its Composition; and as Mrs. *Stephens's* Powder which she used long before she gave the Soap in any Quantity (*d*), and which she still lays great Strefs upon, is no other than a Lime; it is very reasonable to expect great Benefit from Lime-water; which has this further Advantage, that by its Means the Virtues of a greater Quantity of Lime may be safely conveyed into the Blood; for in Soap the Lime bears so small a Proportion to the other Ingredients, that but a very inconsiderable Quantity

A 2

of

much Water as is necessary: Of this Mass, from three to four Ounces are to be taken every Day, made into Rolls a little taper at each End, which are to be laid length-ways on the Tongue, and swallowed with a Mouthful of Water. In this Way the Quantity of Soap to be taken daily, is nearly from two Ounces and five Drams, to three Ounces and a half; of Lime-powder, from three Drams to near half an Ounce; and of Salt of Tartar, or purified Potash, from a Scruple to near half a Dram.

(*d*) *Hartley's* Supplement to the present View, p. 2.

of it can in this Form be mixed with our Fluids (e), and of the Powder (already half slaked, and consequently greatly weakened by being exposed sixty Days to the open Air) only a few Scruples are exhibited a Day. If this Powder is swallowed without enough of Liquids along with it, it may be of bad Consequence, and, I am afraid, has been the Occasion of great Heat and Uneasiness in many People's Stomachs;

(e) In *England* they make Soap with a Lye of Potash and Quick-lime, boiled up with Fat and Oil to a proper Consistence; and it is upon the Supposition of *Alicant* Soap being also made in this Manner that Dr. *Hales's* Experiments mostly proceed; for having found a Lye of Potash and Quick-lime which is of a Nature most intolerably fiery and corrosive, to dissolve the Stone more quickly than any thing except Spirit of Nitre, it was reasonable to expect that Soap, of which this constitutes so considerable a Part, should be possessed of a dissolving Virtue likewise. But I have been informed that at *Alicant* in *Valencia*, where the best Soap is made, there is no Quick-lime used in its Composition, but instead of it only Lime-water, which, together with alkaline Salt got from the Ashes of the Herb *Kali*, and with Oil of Olives, is boiled in large Caldrons that hold several Tons, till it acquires a proper Thickness, when they pour it out on a Floor, and, before it hardens, cut it into Bricks. See also *Lemery's Dictionnaire de drogues*, p. 485. *Savon est une composition fait avec l'huile d'olives la plus grossiere, de l'amidon, de l'eau de chaux, & de la lessive tirée de cendres du kali.* *L'amidon*, the Starch, he tells afterwards, is only sometimes added in order to make the Soap whiter and turn sooner thick.

nachs; and if it is sufficiently diluted, especially with White-wine, Cyder or other acedent Liquors as Mrs. *Stephens* directs, it can have little other Effect than weak Lime-water. When to all this it is added, that Lime-water is found by Experience to dissolve a Stone out of the Bladder, is it not reasonable to expect, that when taken in large Quantities, and but little weakened by the drinking of other Liquors, the Urine likewise may be so far impregnated with its Virtues, as to acquire a Power of dissolving the Stone?

But as reasoning *a priori*, unsupported by Experience is not sufficient to ascertain the Virtues of any Medicine, I embraced the first Opportunity that offered to make a Trial of Lime-water; the Effects of which will best appear from the following History.

Mr. *David Millar*, Master of the Grammar-school of *Kirkaldy*, about sixty Years of Age, had been often distressed by Stones passing from the Kidneys to the Bladder since the Year 1704. Sometimes he has had severe Fits of Pain once or twice in a Year, and sometimes but once in two or three Years, and these of two, three or four, and even of eight or fourteen Days Continuance; but always in few Days after these Fits he voided one or

more Stones till *June* 1740; when, after a painful Fit of Distress and Sickness for two Days, the Stone arrived at his Bladder; but though he used his ordinary Means of riding, walking quick, jumping, and drinking plenty of proper Liquors to make it pass, yet all his Endeavours were in vain.

For half a Year after this, he was troubled with frequent Obstructions in making Urine, altho' without any great stimulating Pain except in voiding the two or three last Drops. Afterwards he thought he found the Stone increase, and become heavier in his Bladder; and since *March* (1741), upon riding or walking a Mile or two, his Urine was always mixed with Blood: Besides, from the Beginning of *January* he had lost all Power of retaining his Urine, so that it went from him every eight or ten Minutes, which was accompanied with great stimulating Pains; yet sometimes with Intervals of Ease for a Day or two, after sweating and keeping warm.

At first he drank Milk and Water, but in *May* (1741) he began to take Soap, first to the Quantity of half an Ounce every Day, which in the End of *July* he increased to an Ounce, and in the Beginning of *September* to near an Ounce and an half; but all this without any sensible

sensible Relief, his Pain, bloody Urine, and Inability to retain his Urine, still continuing as before.

In the End of *September* I advised him to drink with the Soap large Quantities of Lime-water, beginning with one Pound, and gradually increasing the Quantity to three Pounds a Day, and at the same time to drink no more of any other Liquors than was necessary to quench his Thirst.

Within four or five Days, after he began to drink the Lime-water, he recovered in a great Measure the Power of retaining his Urine; and from that Time had less Pain and less bloody Urine, upon using Exercise, than formerly; so that on *November 13.* although he walked upwards of six Miles pretty quick, yet he retained his Water for nine or ten Hours together; and as he voided it with little or no Pain, so he found no Blood mixed with it.

November 15. at Night, when going to Bed, and trying to make Water, he found a Stone entering the Beginning of the *Urethra*, and obstructing it; which it continued to do all Night. He slept little, and often attempted to pass Urine; but could not, unless a very little, and that Drop after Drop. Next Morning, when he was putting on his Cloaths, finding an In-
clination

clination to make Water, and endeavouring it with all the Force he could, he voided a smooth Stone about the Bulk of a common Bean, of a whitish washed Colour; whereas all those he had passed formerly, were of a brown Colour, and rough. It appeared plainly to be a Part of a larger Stone.

Upon the 17th of *November* he walked upwards of two Miles without any Pain or bloody Urine.

November 18. after making Urine he felt something at the Neck of his Bladder, occasioning a slight obtuse Pain, which he took to be another Stone.

From this till the Beginning of *December* he was very easy, not having been obliged, above three or four times a Day, to make Water; which was never mixed with Blood, nor attended with those stimulating Pains he formerly had. Only twice or thrice he found his Urine suddenly stop, when he was voiding it; and once he thought a Stone was entring the Passage, which a little after fell back into the Bladder. When he stumbled, or stepped down a Stair, he still felt something heavy that pushed or touched him in the under Part of the Bladder. His Urine during all this Time had a great deal of white Sediment, and some brownish

ish Flakes among it; but he was so much abroad about his Business, that he could not make any regular Observations upon it.

Upon *Thursday* Night, the 3d of *December*, the Stone which he supposed to have been still in his Bladder entered the Beginning of the *Urethra*; where it stuck till *Monday* Morning following: During which time his Urine was very much obstructed, coming away in Drops, or in a very small Stream, with a good deal of Uneasiness and Pain. From this to the End of *December* he was often in the same Condition, the Stone sticking in the Passage sometimes half a Day, sometimes a whole Day and a Night, and then falling back into the Bladder; but all these Times he never had any of those piercing stimulating Pains which he was wont to feel, before he used the Lime-water, in passing his Urine, and especially after the last Drops; and now also he was able to retain it half a Day, and then void it without Pain. Immediately after emptying his Bladder, he always sensibly perceived the Weight and Pressure of the Stone, if he but walked a little; but when there was any Quantity of Urine in it, this became less perceptible. He concludes a Letter to me at this time with these Words. *As I have hither-*

to enjoyed a good Degree of Health, so now I am easy beyond Expectation, which makes me think the Stone in a dissolving State, and that its Surface is very much smoothed. I continue using the Soap and Lime-water daily; which last I frequently take to my Meat, instead of other Drink, and I think my Urine tastes a little of it.

On Monday, January 4. at Night, he found a Stone had got into the Beginning of the Urethra, which in a good measure hindered him from voiding any Urine. However, next Morning, after a good Sleep it came away. It is larger than the one he passed before, and is evidently a Piece of the same Stone.

For some Days after passing this Stone, he found the Urethra very tender, and a little pained; which occasioned his making Urine more frequently than usual. But this soon went off; and ever since, to use his own Words, he has been perfectly free of all Pains and Symptoms of the Gravel, and as easy in that Respect as ever he was in his Life; and upon the whole, concludes, that he received more Benefit from the Lime-water, than any thing he ever used, and to it chiefly ascribes what has happened above.

As

As Authors have sometimes been accused of framing Histories to support a certain Theory, or raise the Value of some favourite Medicine, I thought it might be proper to add the Gentleman's own Attestation of the Truth of what has been above related.

Kirkaldy, June 1. 1742.

Having read the History of my Case drawn up by Dr. Whytt, I do here, for the Satisfaction of the Publick, declare, that it is in every Particular agreeable to Truth: and that at present I am as perfectly free of all Symptoms of the Gravel as ever I was in my Life.

DA. MILLAR.

Upon this History it is natural to observe,

1. That from the Figure and Shape of the Stone first passed, it evidently appeared to be a Fragment of a larger one, that had lain in the Bladder for about seventeen Months, but then was broken, and in some Degree dissolved; and as of this no other Cause can be assigned, but the *Soap* and *Lime-water*, it is but reasonable to ascribe it to their Efficacy. That part of the Stone where it has been broke off, has its Edges so sharp, while every where else it is smooth and rounded, and a
red

red *Nucleus* so plainly appears in the middle of it, that no reasonable Doubt can be had of its being Part of a larger Stone. But this is put beyond all Question by the Stone last passed, which tallies pretty exactly with the former, is evidently of the same Texture, and the two together, excepting a small Deficiency at one End, seem to make up a compleat Stone. Whether what is wanting has passed in Fragments unobserved, or has come away quite dissolved in Flakes and white Sediment, is not so certain. Besides, as he has had no Stones passing from his Kidneys to his Bladder since *June 1740*; if we deny these Stones to have been one, we must suppose them lodged eighteen Months in the Bladder, without either acquiring a greater Bulk, or ever endeavouring to pass; none of which Suppositions are at all likely.

2. The Surfaces of the Stones shew them to have been in a dissolving State. There are Fibres like Roots which run along them, in some Places plainly broken off, and the hollow Furrows they had made still remaining. And as the *Lime-water* and *Soap* had longer Time to act upon the second Stone, so we find still more evident Signs of Dissolution about it. It has in most Places a very rotten Appearance,

Appearance, and in some is eaten so deep, that one can see several of its concentrick Layers. Further, as Dr. *Hales* has observed, (which will more fully appear in the following Experiments), that the *Calculus* generally turns white in dissolving, the whitish Colour of these Stones makes it probable they were in a dissolving State.

3. It does not appear that the Soap alone had any great Influence in this Case: For although from the End of *July*, till about the 8th of *September*, he took an Ounce every Day, and after that near an Ounce and an half; yet he found no sensible Relief; which probably might be owing to his not taking it in so large Quantities as some others have done (*f*).

4. It would seem that *Lime-water* has a very uncommon Efficacy in easing the Symptoms, and probably dissolving the Stone in the Bladder: For in five Days after Mr. *Millar* began to drink it, he was able to retain his Urine better than he had done for eight or nine Months before, and found the stimulating Pains in making it less, and the Quantity of Blood in it sensibly to diminish; so that

B

upon

(*f*) The mean Quantity ordered by Mrs. *Stephens* is two and a half Ounces.

upon the 13th of *November*, although he walked six Miles pretty quick, he had none of it, nor has had ever since; and on the 16th of the same Month (having used it little more than six Weeks) he passed the first Stone. Nor is it at all unreasonable to suppose that *Lime-water* may have a greater Effect in dissolving the Stone than *Soap*, since we find it possesses a greater dissolving Virtue out of the Bladder. See *Experiments below*, Sect. 3. compared with N^o 70. and the Table near the End of this *Essay*.

That the *Lime-water*, from its Astringency and strengthening Quality, should have a more sudden Effect in curing the Incontinency of Urine, than the Pain and Blood that, upon Motion, generally accompanied it, is easily accounted for; since, as the two last proceeded chiefly from the rough Sides of the Stone grating upon, and tearing the Blood-vessels on the internal Coat of the Bladder, this must in part have continued to happen till the Points were worn off its Surface; and accordingly we find the first Stone was pretty smooth when he voided it. But, besides this, after the Stone once begins to dissolve, its Surface is either covered with a whitish *Mucus*, or soft rotten Scales or Layers, which are thrown off one after another. *Vid. Exper. below.*

5. It may not be amiss to take notice, that although Mrs. *Stephens's* Medicines almost always occasion great Pain and Heat of Urine for some Weeks, or even Months, after first taking them (g); yet the *Soap*, in the Way Mr. *Millar* took it, gave him no such Uneasiness; and the *Lime-water* had so very contrary an Effect, that in a few Days it relieved some of his Complaints, and abated others. As the Pain and Heat of Urine in taking these Medicines seem chiefly owing to the alkaline Salt, which bears so great a Proportion in the Composition of the *Soap*, is it not probable, that it was from his beginning to take the *Soap* in very small Quantities, and gradually increasing the Dose, as well as never taking so much of it as is ordered by Mrs. *Stephens*, that Mr. *Millar* escaped this Complaint?

Finding his Stomach unable to bear the *Soap* in Decoction, he took it every Morning in Substance, only sliced down; and found it agree very well with him, excepting that it sometimes gave him a little of the Heartburn. And the *Lime-water* and *Soap* were so far from having any bad Effect upon his Health, that he

B 2

rather

(g) See Dr. *Hartley's* View of the present Evidence, &c. and Dr *Kilpatrick's* Case, written by himself.

rather found himself easier and lighter, and considerably freer of some kind of Lowness of Spirits he had laboured under.

6. As Mr. *Millar* continued from the Beginning of the Year 1742, when this Paper was first written, to *June* 1751 when he died, perfectly free of all Symptoms of the Stone, without taking Medicines of any kind, so there can be no Doubt but that the Stone, which gave him so much Uneasiness, was wholly brought away by the Use of the Lime-water and Soap; for if any Part of it had remained, it must, in so long a Time, have acquired Bulk sufficient to have produced the like uneasy Symptoms, with which he had been formerly afflicted. And here it is worthy of Observation, that Mr. *Millar*, by the Use of these Medicines was not only cured of the Stone in the Bladder, but rendered, during the Remainder of his Life, almost quite free of nephritick Complaints, to which he had been very subject for many Years before.

By this Success of the *Lime-water*, I was induced to make the following Experiments, with a View to a further Discovery of its Nature and Virtues.

S E C T.

SECTION I.

Experiments with Quick-lime.

MALT SPIRITS poured upon a Piece of fresh calcined Lime-stone, are plentifully absorbed by it, without any sensible Ebullition, (some Air-bubbles excepted, that arise from its Surface); nor is it flaked but after lying a great many Hours in them.

I immersed a Piece of Quick-lime in rectified Spirit of Wine, in a close stopped Bottle, which after eight Days scarcely shewed any Appearance of being flaked.

2. Vinegar is somewhat more plentifully absorbed by Quick-lime than Spirits, with a good many Air-bubbles, and hissing Noise at first, which however soon ceases; and if the Lime is fresh from the Fire, it will scarcely be flaked, unless allowed to continue many Hours in it.

Water, whether cold or hot, poured upon Quick-lime that has lain sometime among Spirits or Vinegar, produces no Ebullition, except a very few Air-bubbles at first; and the Stone that has been in the Vinegar is longest in being flaked.

3. Oil is plentifully imbibed by Quick-lime, without any Ebullition or Heat. If there is any Rent in the Stone, a few Air-bubbles will sometimes rise out of it. When put in boiling Water after this, a good many Bubbles of Oil rise from the Surface of the Stone; and, after several Hours standing, it begins to melt down into a soft, fat, argillaceous Substance.

Hence it seems probable, that Oil, by filling the empty Pores, and sheathing perhaps the fiery Particles of Quick-lime, destroys its Efficacy so as to hinder its Ebullition with Water: While, on the other hand, Oil has its Nature so far changed by Lime, that it becomes miscible with Water (*b*).

4. Upon putting a Piece of Quick-lime in Claret Wine, a considerable Ebullition immediately happens; but in twenty four Hours the Stone is scarce dissolved.

A Piece of Quick-lime being put into brisk strong Ale, a good many Air-bubbles immediately

(*b*) *Oleum solum calci miscetur, quando utrumque aquas odit. Plin. histor. natur. Lib. 24. cap. 1.*

Calx aqua accenditur, eademque oleo restinguitur. Id. Lib. 33. cap. 5.

Si oleum rosarum vel liliorum alborum vel lini probe agitetur in mortario cum aqua calcis, ambo coalescunt in modum butyri. Etmuller.

diately arose with some Noise; but this was quickly over. After twenty four Hours one third of the Stone was not flaked.

Small Beer has much the same Effect; only the Ebullition is greater, and lasts longer.

Water, whether cold or hot, poured upon a Piece of Quick-lime that has lain some time in Ale or Beer, produces no Ebullition, nor easily dissolves it.

5. The Heat or Cold produced by the Mixture of the above Liquors with powdered Quick-lime, I found to be as follows.

When Quick-lime was mixed with Lamp-spirits, the Thermometer fell, in two or three Minutes, from 54 to 53 Degrees.

With Vinegar it rose, in five Minutes, from 52 to 68 Degrees; after which it began to fall.

With Claret it rose, in six Minutes, from 51 to 56 Degrees.

With strong Ale it rose, in ten Minutes, from 48 to 57 Degrees.

With cold Water it rose, in twenty two Minutes, from 48 to 112 Degrees, and then began to fall (i).

6. Ten

(i) The Quantity of Quick-lime used in this Experiment was very small, otherwise the Thermometer would have risen much higher.

6. Ten times its Weight of boiling Water being poured upon fresh burnt Lime-stone, there immediately arises a great Ebullition, which lasts a considerable Time; when this is over, the Lime falls to the Bottom, and the clear Water above, being filtrated through brown Paper, is that which I made use of in the following Experiments. The Proportion of 8 to 1 ordered in the *Edinburgh Dispensatory*, seems rather too small, as it affords but very little Water, if the Lime-stone be well burnt, and fresh from the Fire: Nor have I observed any remarkable Difference in the Strength of the Lime-water made with these different Proportions.

Cold Water being added to Quick-lime, soon produces a considerable Heat and Ebullition, and this Water has the same Virtues as the above.

7. If Quick-lime be mixed with fresh Urine, it instantly sends forth a pungent Vapour which strikes the Nostrils in much the same Manner as volatile Ammoniac Salt.

S E C T.

S E C T. II.

Experiments with Lime-water upon Urine.

As the calculous Concretions of the Kidneys and Bladder are generated by the Urine, and owe their Growth entirely to a constant Apposition of Particles derived from that Fluid, I thought it might be worth while, before making any Experiments on the *Calculus*, to try the Effects of *Lime-water* upon *Urine* and its *Sediment*.

8. If two Ounces of Lime-water be added to an equal Quantity of fresh-made Urine, the Mixture instantly becomes whitish and turbid; and, in a little Time, a light white Sediment falls to the Bottom, leaving the Liquor above perfectly pellucid, of a fine light Limon-colour (*k*), without any Scum or Crust on the Sides of the Glass.

9. I let some fresh Urine stand by itself in a Glass about forty eight Hours; in which Time it had deposited a redish brown Sediment upon the Bottom of the Glass, with a Crust of the same Nature upon its Sides. I then

(*k*) This, as well as the Quantity of white Sediment, varies according to the Strength of the Urine.

then decanted off the clear Urine, leaving the Sediment and Crust alone, and filled up the Glass with Lime-water: Upon which the Sediment immediately rose from the Bottom, lost its Colour, and the Mixture became white and turbid; the Crust on the Sides of the Glass quickly disappeared; and in a short time a large light white Sediment fell to the Bottom which, though allowed to stand thirty Hours, did not in the least adhere to, or leave any Crust upon the Bottom or Sides of the Glass.

Having poured off what was clear, I added some White-wine Vinegar to this Sediment; upon which it immediately disappeared, and the Liquor became pretty clear, not unlike Sherry; which however, after some Hours, let fall a dark-coloured Sediment.

α Hence we see that Lime-water has not only a Power of hindering the Urine from resolving into those Principles which are imagined to give Rise to the Stone, but also of destroying and changing their Nature after they are separated from it; whence arises a strong Probability, that it may not only hinder the Generation of the Stone in the human Body, but dissolve it after it is formed: Nay, altho' it should be allowed, that Lime-water

water does in a great Degree lose its dissolving Power before it arrives at the Bladder; yet if it shall, by destroying the petrifying Quality in the Urine, hinder any new Accretions to the *Calculus*, this must necessarily in Time have its Surface washed down, and worn away, by the Urine continually running along it, and the Coats of the Bladder acting upon it; as we find even the hardest Rocks yield to common Water.

*Quid magis est saxo durum? quid mollius unda?
Dura tamen molli saxa cavantur aquâ. Ovid.*

But that the dissolving Quality of the Lime is really communicated to the Urine, evidently appears from Experiments made with the Urine of such Patients as have taken Mrs. *Stephens's* Medicines for a considerable Time in large Quantities. Thus Mr. *Geoffroy* found, that a pretty hard *Calculus* had lost something of its Weight, and had its Surface corroded, by having daily poured upon it for ten Days the fresh Urine of a Patient who had taken Mrs. *Stephens's* Medicines for upwards of a Month (*m*). And, if I remember right, much the same Experiment

(*m*) *Memoires de l'Acad. des sciences, an. 1740. Edit. 8vo p. 261. 262.*

periment was tried by Dr. *Kirkpatrick* on his own Urine, and with the same Success (n).

β Do not these Experiments afford us a clear Reason why the Stones which Mr. *Millar* passed after drinking the Lime-water, were of a whitish Colour, whereas all that he had voided, for thirty Years before, were brownish? And do they not likewise render it probable, that the great Quantity of white Sediment in the Urine of such People as have taken Mrs. *Stephens's* Medicines, has been owing to the Action of the Lime contained in them? For we find Lime-water produce that Sediment in Urine out of the Bladder, and by drinking Lime-water Mr. *Millar's* Urine deposited it in great Abundance. The Quantity of this, however, will be increased by what is daily washed off the Surface of the Stone by the Efficacy of the Medicines.

Does it not likewise appear plain from these Experiments, why Dr. *Jurin's* Urine (o) (especially after his largest Dose of *Soap-lees*) was whitish and turbid when he first made it, and afterwards deposited a *calcareous* Sediment, as he calls it; but which, notwithstanding the Opinion that has hitherto prevailed of its being furnished

(n) See his Case written by himself.

(o) *Jurin's* Case, p. 12.

furnished in a good measure by the Medicines (p), seems to have been owing solely to the Change made by the Lime upon the Sediment of the Urine. And that Lime-water not only changes the Colour of the Urine, but of the Surface of the *Calculus* itself, plainly appeared in a Stone (taken from the Body of *John Greig*, who died *December 1741*, in the Royal Infirmary, of an Iliac Passion) which had its external Surface almost entirely white and a little rotten, while within it was of a sandy Colour. Of this no Reason could be assigned, but his having drank Lime-water for eight Days, to the Quantity of about an *English Pint* a Day. And it is observable, that as he left off the Lime-water eight or ten Days before his Death, so in some Places there was a brownish Crust beginning to grow over the white Surface.

10. *April 15*. I put into a Phial a Scruple of Oyster-shell Lime and ten Drams of fresh Urine. Into another, I put the same Quantities of Salt of Tartar and fresh Urine: Both these Mixtures immediately sent forth a Vapour which affected the Nose with a pungent Ammoniacal Smell. Into a third Phial I put equal Parts of fresh Urine and Lime-water, which gave an extremely faint Smell of the same kind. And,

C

into

(p) Hales's *Experim.* p. 12.

into a fourth one, the same fresh Urine alone. Having corked these several Phials, I did not open them till the 16th of *May*, when the Urine with Quick-lime had an extremely offensive Smell, not to be described in Words. The Urine mixed with Lime-water had a disagreeable Smell of the same kind, but not so strong. The Urine with Salt of Tartar smelled like stale Urine, and did not affect the Nose near so disagreeably as the two former. The Urine without any Mixture had a stale Smell, but not so strong as that which was mixed with Salt of Tartar.

Hence it appears that Quick-lime, Lime-water and fixed alkaline Salts not only volatilise the Salts of the Urine, but also corrupt its Oils, altho' Quick-lime and its Water produce this last Effect much more remarkably than the alkaline Salt.

S E C T. III.

Experiments with Lime-water upon the Calculus.

In the following Experiments I made use of two *Calculi*.

The first, which, for Brevity, I shall denote by *A*, was given me by my ingenious Friend and Collegue Mr. *Monro* Professor of
Anatomy

Anatomy in this Place. It was of a close Texture, and very hard, and of a grey sandy Colour.

The second, *B*, was the one which I just now mentioned to have been taken out of *John Greig's* Bladder. It seemed fully as hard as the former, and was capable of receiving a pretty fine Polish. It weighed an Ounce and a half, and its specifick Gravity was to that of Water, as 1704 to 1000. Its Colour was pretty much the same with the former.

11. A Fragment of *A* weighing 23 Grains, being put in Stone Lime-water, and kept in a moderate Heat, was mostly all rotten and dissolved in little more than thirty Days.

A Fragment of *B* weighing 10 Grains, after two Days and nine Hours warm Digestion in the same Lime-water, had two Grains of its Substance rotten and dissolved.

12. Some Stone Lime-water that I made by slaking Quick-lime with boiling Lime-water, dissolved a Piece of *A* of five Grains in about seven Days.

13. A Fragment of *A*, Gr. vi. after seventeen Days cold Digestion in Stone Lime-water in the Month of *February*, had lost none of its Weight, nor was its Surface very sensibly softened, altho' it had somewhat of a rotten Ap-

pearance; while a Piece of *B* of 12 Grains, in six Days cold Maceration in the End of *May*, had two and a half Grains of its Weight dissolved.

From this Experiment, together with N^o 20. and 57. below, one may be able to account for Dr. *Lobb's* having found Lime-water to have no Power of dissolving the Stone (*q*): For if the Lime-stone used in making the Water was not fresh from the Fire (*r*); and if the Experiment was made in an open Vessel, and in the Winter-season, it is no great Wonder if, even after a cold Maceration of twelve Weeks, there was no Appearance of Dissolution about it.

It is observable, that although the Chymists seem generally to have been of opinion, that there lay concealed in Quick-lime a powerful Remedy against the Stone, which by their Art might be extracted out of it; yet none of these Authors, that I have met with, among the many Diseases for which they have highly commended Lime-water, so much as hint at its being serviceable in the Stone or Gravel;

in

(*q*) Treatise of Dissolvents of the Stone, p. 326.

(*r*) That this was the Case, is highly probable, since he made his Water with unslaked Lime, which he, in the next Paragraph, tells us was Lime a little slaked.

in which Diseases, however, its Virtue is perhaps more remarkable than in any other: And one may almost venture to affirm, notwithstanding the Boastings of many Chymical Writers, of their Spirit of Quick-lime, and other secret Preparations of it, that its Virtues are more easily extracted, and more safely conveyed into the Blood by its Water, than any way else.

Having thus found a considerable Power of dissolving the *Calculus* in Stone Lime-water, I thought it might be worth while to inquire, whether Shell-lime possessed the same Virtue, and whether in a greater or lesser Degree.

14. A Piece of *A* weighing nine Grains, was dissolved by lying seventeen Days in Lime-water made with calcined Egg-shells, in a digesting Warmth; and this, I am apt to think; might have happened somewhat sooner, had the Shells been more carefully calcined.

15. A Fragment of *A* of six Grains was, by two Days warm Digestion in Lime-water made with Oyster-shells, reduced to two Grains, and in three Days to less than one Grain.

16. A Piece of *B*, eight Grains, in thirty six Hours warm Digestion in Oyster-shell Lime-

C 3. water,

water, had about three and one fourth Grains of its Substance dissolved.

17. Having calcined a few Cockle-shells, that had lain long exposed to the Weather, I put a Piece of *B*, eight Grains, in some of the Lime-water made with them; which in thirty six Hours warm Digestion lost near three and a half Grains.

The Lime-water, especially that from Shells, generally dissolves the Stone by making it throw off white rotten Crufts or Scales; which, if allowed to lie long enough among the Water, and if the Glass be shaken now and then, are reduced to a sort of white *Mucilage*, resembling in some Degree the white Sediment of N^o 9.; but which, when dried, has the Appearance of fine powdered Chalk. This serves farther to shew that the white Sediment in the Urine, of such as drink Lime-water, is not derived from the Lime, but wholly from the Parts of the Stone, and grosser Parts of the Urine, thus changed by the Lime-water (*f*).

18. A Piece of *A*, six Grains, was rendered pretty soft, and entirely rotten, by a cold Maceration of seventeen Days in Oyster-shell Lime-water, in the Month of *February*; but

(*f*) See No. 9. above.

but *May 19.* having infused, cold, a Fragment of *B*, eleven Grains, in some of the same Lime-water, it lost in three Days near five Grains, and in eight Days was reduced to a *Nucleus*, weighing three Grains.

Here it may be proper to observe, that, unless the *Calculus* be small, and the Quantity of Lime-water in which it is immersed, be large, the Water must be renewed at different Times, since its Virtues are weakened in proportion to the Quantity of the Stone which it has dissolved; and, as far as I have been able to observe, less than half a Dram of *Calculus* reduced to a fine Powder, is sufficient to destroy the Virtue of two Ounces of strong Lime-water in which it is infused.

From these Experiments it appears, that Oyster and Cockle Shell Lime-water possesses a much greater Power of dissolving the *Calculus*, than that of Stone-lime. Nor is this last only inferior in its lithontriptick Virtue, but also as it is less homogeneous and safe, since the Lime-stone may be impregnated with metallick or mineral Principles, which even the Fire may not be able wholly to destroy.

Although, as has been already hinted, I don't find that Lime-water has been prescribed till of late in the Gravel, or for dissolving the
Stone

Stone in the Bladder; yet, since the first Publication of these Papers, I have met with a Passage in an Epistle of *Olaus Borrichius* to *Thomas Bartholine*, by which it plainly appears, that the Power of Shell Lime-water to dissolve the *Calculus* out of the Bladder, was long ago known to this Author. His Words are, *Constat autoritate Basiliæ Valentini aliorumque, nihil in calculo profigando utilius spiritu calcis vivæ; mihiq; iterum iterumque compertum aquam calcis vivæ ostreorum, mytilorumque, solvere calculos ordinariè ab ægris exsectos in mucilaginem, si aliquot dierum leni fœtu in calido simul detineantur (t).*

19. In order to know what Proportion of Water was best to be added to the Shell-lime, I poured twenty one Ounces of boiling Water upon three Ounces of fresh calcined Oyster-shells, reduced to a gross Powder, and a great Ebullition soon ensued, which lasted a considerable Time. A Piece of *B*, thirty one Grains, by lying thirty six Hours in this Lime-water with a Heat betwixt that of the human Body and melting Wax, lost seven Grains of its Weight.

Having afterwards added twenty five Ounces of boiling Water to two and a half Ounces of

(t) *Bartholin. epist. centur. iv. epist. 76.*

of the same calcined Shells, there did not happen any such strong Ebullition as before; only a Noise at the Bottom of the Vessel, and some small Agitation in the Liquor, such as commonly is to be observed in Water before it begins to boil. A Piece of *B*, thirty one Grains, being kept thirty six Hours in this Lime-water in the above mentioned Heat, lost only five Grains.

To make therefore Lime-water with Oister or Cockle-shells, the Proportion I would recommend is 7, or at most 8 *lib.* of Water to one of calcined Shells (*u*). Nor is there any Danger in the Strength of Lime-water made in this Manner; for I have ordered near four *English* Pints of it to be drank by a Man, and two by a Boy of eight Years of Age, every Day, without any Inconveniency.

The Shells will calcine in any Fire, provided it be hot enough: and the Cockle and Oister with much less Trouble than the Egg-shells. If they are friable, and quite white, they are sufficiently burnt; but if blackish or grey, they must be put into the Fire again.

It is to be observed, that the Quantity of Water used to make it, is in a great Measure, as it is to be used.

(*u*) An earthen Vessel is preferable for this Purpose to a wooden or Copper one, as the first will probably give it a bad Taste, and the second possibly a worse Quality.

It may perhaps be worth while to observe, that if the calcined Shells are taken from the Fire while it burns strong, or before it is become very weak, the Water poured upon them generally gets a very disagreeable sulphureous Taste. This I was ready, at first, to ascribe wholly to the Coals. But as Lime-water made with Oyster-shells newly brought from the Sea, gives a stronger sulphureous Smell, when mixed with Spirit of Vitriol, than Lime-water procured from Shells which have been many Years exposed to the Weather; it is probable that the sulphureous Taste here mentioned may have in part been owing to this last Cause.

If cold Water be poured upon Shell-lime, very little Heat or Ebullition ensues; yet the Lime-water thus procured seems to have as great a Power of dissolving the Stone, as when made with boiling Water; but is more harsh and disagreeable, the other having a Softness and Sweetness which this wants.

The Water, whether cold or hot, should be allowed to stand nine or ten Hours on the Shells, or longer if the Quantity of Water added to them, is in a greater Proportion than eight to one.

If

If any one before reading this Paper, should chance to have consulted Mr. *Lemery* upon Lime-water, either in his *Chymistry* or *Pharmacopée universelle*, he will perhaps be surpris'd to find three or four *English* Pints of this order'd to be taken every Day, while that learned Chymist talks of its Dose, as from one to four Ounces; speaks of its raising great Thirst, and being in Danger of burning the Stomach; upon which account he orders Syrup of Violets to be mixed with it, and prefers the second Water to the first. Perhaps from such Authority it partly was, that many Physicians have been us'd to prescribe this Medicine with sparing a Hand; and I own, that first when I began to order Lime-water for the Stone, I was afraid to exceed an *English* Pint of it a Day; but, as repeated Experience has taught me, that there is nothing to be dreaded from it when taken in much larger Quantities, I imagine Mr. *Lemery's* Suspicions of its doing Mischief in large Doses, or when taken unmixed with any thing to soften it, were not so much owing to any Experience of its bad Effects, as to Theory. Quick-lime is remarkably corrosive, and seems to act by its Fire; therefore it was natural to think, that Lime-water impregnated

pregnated with the same Fire, might have the same Effect, though in a less Degree.

20. I infused a Fragment of *B*, seven Grains, in some Lime-water made with Oyster-shells that had lain thirty five Days in the open Air after calcining; which, being kept in a moderate Heat for four Days, had only about three Grains of its Substance rotten and dissolved; whereas a Piece of *B*, eight Grains, by digesting three Days and twelve Hours in Lime-water made with Shells fresh from the Fire, lost about six Grains: Nay, I have observed, that after the Shells have been but fifteen or twenty Hours from the Fire, they neither make such an Ebullition with the Water, nor have so great dissolving Power, as when just taken warm from it.

I have made Experiments with Lime-water and several other Stones, but have never yet met with any that were able to resist the Oyster or Cockle Shell Lime-water, although some that were extremely hard, and of a dark brown Colour, dissolved a good deal slower than either *A* or *B*.

I had indeed sent me a few small Stones, all of them of a particular Shape, resembling pretty much the Stone of a Raisin, perfectly smooth, and variegated something like a polished

lished Pebble; to which their exterior *Cortex* scarcely yielded in Hardness. Upon these the Lime-water had no manner of Influence. But if these Stones came from the urinary Passages, as I was told, they were of a Texture quite different from all the Gravel-stones I have ever seen; and their being all pretty much of one Bulk and Shape, makes it probable that they were generated in some particular Cavity. In the *Philosophical Transactions* (v) we have the History of a Woman in *Switzerland*, who passed by the *Anus* great Quantities of Stones like Flint. And I have seen a Concretion passed by Stool, longer, but not so thick as a Hen's Egg, with its exterior *Cortex* as smooth as a polished Pebble, though internally it was of a spongy fungous Consistence. In the same *Transactions* we read of a Shell having been found in one of the Kidneys of a Lady who had been often subject to violent Vomitings (w); which it is very likely the Lime-water would not have dissolved. And *Bartholine* mentions Stones said to have been extracted from the Bladder, of a flinty Hardness (x); though *Olaus Borrichius* seems to doubt of this (y). But as these Con-

D

cretions

(v) Lowthorp's Abridgment. Vol. 3. p. 167.

(w) Lowthorp's Abridgment. Vol. 3. p. 162.

(x) Epist. 45. cent. 4.

(y) Barthol. epist. 76. cent. 4.

cretions are as different in their Nature from common *Calculi*, as Flint or Shells are from Free-stone, and besides are extraordinary and very rare, Lime-water (especially that from Oister or Cockle Shells) may be still looked upon as a pretty universal Dissolvent of calculous Concretions.

As the calculous Concretions of the Urine have been thought to have some Analogy to the tartarous Cruft left by Wine upon the Sides of the Cask, it may perhaps be worth while to observe, that Lime-water dissolves *Tartar* pretty quickly; but, as its Virtue is soon destroyed by the Acidity of the *Tartar*, the Affusion of fresh Lime-water must be frequently repeated.

21. The Reverend and ingenious *Dr. Stephen Hales* having wrote me last Summer (1751), that he had found Oister-shell Lime-water, made with a Pound of Lime to an *English* Gallon of Water, rendered sensibly more pungent to the Taste, as well as a more powerful Solvent of the Stone, by pouring it on calcined Shells red-hot from the Fire; I made the following Experiments with a View to determine with some Precision the different Strengths of different Lime-waters.

(a) *June*

(a) *June 6.* At Nine in the Evening, I poured upon a Pound of calcined Oyster-shells hot from the Fire, seven Pounds of boiling Water.

(b) Next Day, at Eight in the Evening, I poured two Pounds of this Lime-water upon half a Pound of calcined Oyster-shells newly taken from the Fire, and still warm. Thirteen Hours after this, I decanted off and filtered fourteen Ounces of each of these Waters.

(c) At the same time I filtered the like Quantity of Lime-water, which was procured by pouring, forty eight Hours before, seven Pounds of boiling Water upon a Pound of calcined Oyster-shells, which, in the Space of four Days and a half, had formerly got three such Waters.

(d) I filtered also fourteen Ounces of Lime-water, made by pouring seven Pounds of boiling Water upon one Pound of Stone-lime, taken a few Hours before from the Fire.

In order to find the specifick Gravities of these different Lime-waters (the first of which we shall, for brevity's sake, call A, the second B, the third C, and the fourth D), I weighed, with the Assistance of my Colleague Dr. *John Stuart* Professor of Natural Philosophy, a large Glass-phial (filled with Sand, and hermetically sealed) first in Air, and then immersed it in

the Fountain-water of this City (used also in making the several Lime-waters), by which it lost 3704 Grains of its former Weight. Being next weighed in B, it lost 3727 Grains. In A it lost 3720 Gr. ; in C 3710 Gr. ; and in D 3713. Hence it appears that the specifick Gravity of the double Lime-water B, was to that of *Edinburgh Water*, nearly as 169 to 168. The Gravity of A was to that of the same Water, nearly as 232 to 231 ; of C nearly as 617 to 616, and of D nearly as 411 to 410. At another time I found, by the same method, the specifick Gravity of some Lime-water procured from Oyster-shells ; upon which, during the Course of twelve Months, I had at different times poured, at least, a hundred times their Weight of Water, to be to that of Fountain-water, nearly as 926 to 925.

It may be proper to observe, that both A and B were made with Oyster-shells, which had lain buried in the Rubbish on the South-side of the Castle of *Edinburgh*, probably above a hundred Years ; because, if they had been newly got from the Sea, the Salt which they contain even after Calcination, would probably have increased the specifick Gravity of the Waters poured on them, and so have rendered the Experiment less accurate.

The

The Tastes of A, B, C, and D, as well as their specifick Gravities, shewed their different Strengths. A and B had much the same kind of Taste, but B was sensibly more pungent; C had much less Pungency than either of the two former, and left a Sweetishness in the Mouth, somewhat resembling the Taste of Liquorice Root; D did not differ much from C as to its Taste.

I put three Pieces of a very hard *Calculus*, each weighing ten Grains, into three different Phials; one of which I filled with the Lime-water A; another with B, and the third with C. After they had stood in the same Degree of Warmth 93 Hours, I found that the *Calculus* in the double Lime-water B, had two Grains of its Substance dissolved or rotten; the *Calculus* in A had lost somewhat more than a Grain and a half, and that in C, a Grain.

Hence it follows, that Water does not acquire the same precise Degree of Strength, whatever be the Quantity of Quick-lime upon which it is poured; as is observed of Wine, in which *Crocus Metallorum* is infused; but that Lime-water is stronger or weaker in proportion as a greater or less Quantity of Quick-lime is added to the Water; that where the Proportions of these two are equal, fresh cal-

cined Shells impregnate Water more strongly, than such as have had several Affusions before; and that Lime-water, made with calcined Shells, hot from the Fire, may be rendered remarkably stronger, by pouring it a second time on fresh burnt Shells. It is, however, observable, that this double Lime-water, if it stands on the Shells a few Days, loses some of its Pungency and Strength, while the weaker Lime-waters are constantly supplied with fresh Virtue from the Shells, sufficient to make up what they lose by the Contact of the Air.

Farther, we see that Stone-lime does not impregnate Water so strongly with its Virtues as Shell-lime. Whether this may be owing to the greater Subtility of the latter, whereby it more easily mixes with, and is suspended in the Water, or whether it may not proceed from some other Cause, I shall not presume to determine: However, from the greater specifick Gravity of Shell Lime-water, we are enabled to account for its dissolving the *Calculus* more powerfully than Stone Lime-water.

But altho', from the above Experiments, it evidently appears, that fresh calcined Shells afford a stronger Water than such as have been exposed for any considerable Time to the Air, and that the first Water poured on
Quick-

Quick-lime is stronger than the succeeding ones; yet it is far from being true, that Quick-lime is soon deprived of its Virtues by repeated Affusions of Water, or that the third or fourth Water procured from it is altogether insipid, as some have affirmed (z). 'Tis true, indeed, that fresh calcined Shells impregnate Water with their Virtues sooner, as well as in a greater Degree, than Shells which have been in some measure flaked by long Exposition to the Air; and that when repeated Waters are poured upon Quick-lime, it communicates its Virtues not only more slowly, but also, strictly speaking, in a less Degree to each succeeding Water (a): But nevertheless, Quick-lime is so far from having its Virtues wholly extracted by a few Affusions of Water, that some Stone-lime, which had been reduced to a Powder, by being exposed to the open Air for four Months, still retained some of its Virtue, after having had, during

(z) *Memoires de l' Acad. des Sciences* 1700, Edit. 8vo p. 160 and 170.

(a) Calcined Shells, taken fresh from the Fire, will, in a few Hours, communicate all the Virtue they can give to seven or eight times their Weight of Water; but after they have had twelve or fourteen Waters poured on them, several Days must pass before the Water gets all the Strength, which the Lime can give it.

during the Course of sixty Days, 260 times its Weight of Water poured upon it: and some Lime-water procured from calcined Oyster-shells, upon which, in 48 Days, I had poured 270 times their Weight of Water, was, by Experiment, found to be possessed of a considerable Power of dissolving the Stone.

Hence we may see why Lime, which has been used, since the Times of the *Romans* (b), as a Manure retains its Power of fructifying the Ground for many Years.

It follows also, from the above Experiments and Observations, that calculous Patients may not only use, with Advantage, the first, but also several more Waters procured from Quick-lime: And, perhaps, it were advisable for them to begin with the 3d and 4th Waters, and use them for some Days before they try the first Water, which has a more pungent and disagreeable Taste.

(b) *Hedui et Pictones calce uberrimos fecere agros; que sane et oleis, et vitibus utilissima reperitur.*

S E C T. IV.

Experiments with Lime-water and some of the animal Humors.

THE great Power of Lime-water to dissolve the *Calculus*, being sufficiently made out in the above Experiments, the next Subject of Inquiry seemed to be, How far the Nature of Lime-water would be changed by its being mixed with the Humors of our Body, and consequently what Probability there was of its carrying its Virtue along with it to the Bladder?

22. I infused a Piece of *B*, three Grains, in a Mixture of *Saliva* and Oister Lime-water, in the Proportion of one of the former to two and a half of the latter: Its Surface in a few Hours began to turn white; and, upon shaking the Glass, threw off white Scales; and in two Days warm Digestion it was reduced to a Grain and a half.

23. I immersed another Fragment of *B*, three Grains, in an Ounce of *cystick Bile*, and three Ounces of Oister Lime-water, which being kept in a moderate Heat forty two Hours, had near one Grain and a half of its Substance dissolved in the Form of thin whitish Scales.

[23.] A

[23.] A Piece of *B*, five Grains, being infused in one Part Serum of human Blood, and three and a half Parts Oister Lime-water, was, after thirty eight Hours warm and sixteen cold Digestion, reduced to three Grains.

24. I put also a Piece of *B*, five Grains, in a Mixture of one Ounce of fresh Urine and three Ounces of Oister Lime-water: After digesting three Days in the same Heat with the last, its Surface was become all over white, about a Grain of it was dissolved, and the rest somewhat rotten and friable.

Since, from these Experiments, it appears, that the animal Humors have nothing in their Nature peculiarly destructive of the dissolving Quality of Lime-water, we might reasonably conclude *a priori*, that it should carry its Virtue along with it even to the Bladder, and so in time dissolve the Stone.

S E C T. V.

Experiments with Lime-water, and fermented Liquors and Spirits.

HAVING shewn the Probability there is that the animal Fluids will not destroy the Virtue of Lime-water, we come next to inquire,
How

How far it may be affected by such Liquors as are most commonly made use of in this Country.

25. *Claret Wine* destroys the Taste of near double its Quantity of Lime-water, and the Liquor has the Colour of the Wine rather heightened, and the Taste of Wine and Water; but, upon adding a little more Lime-water, it acquires a blackish Colour, not unlike Gun-powder, and begins to discover a little of the Taste of the Lime. The Quantity required to produce this Change of Colour in the Claret varies according to the Strength of the Lime-water. Having once flaked some Quick-lime with boiling Lime-water, I found that the Water made in this Way, turned Claret black, when mixed with it in the Proportion of one and a half to one.

I took two Pieces of A, each weighing twenty three Grains: The one being put in Lime-water, and kept in a moderate Heat, in five Days had near five Grains rotten and dissolved; the other being put in one Part Claret and two Parts of the same Lime-water, and kept in the same Heat for fifteen Days, lost nothing of its Weight, nor was its Surface at all softened.

26. An

26. An Ounce of Lime-water mixed with an equal Quantity of *strong Ale*, not in any Degree stale, having been but fourteen Days in the Bottle, had its Taste quite destroyed, at the same time that it weakened the malty Taste of the Ale more than an equal Quantity of common Water. A Piece of *A*, ten Grains, after lying thirteen Days in this Mixture in a moderate Heat, had lost nothing of its Weight, nor were there any Signs of Dissolution about it.

Small Beer has the same Effect, but in a less Degree.

27. Upon mixing Lime-water and *Vinegar*, there does not arise any Effervescence or Ebullition; one Ounce of the latter destroys the Taste of ten or twelve of the former; and a Fragment of *A* that weighed four Grains, after lying eight Days among this saturated Mixture in a digesting Heat, had lost nothing, nor was it any way softened.

Hence it seems proper for such as use Lime-water, to abstain not only from all Acids, but also from Wine, Ale, and, so far as I have been able to observe, all fermented Liquors. And doubtless Mrs. *Stephens*, by ordering her Powder to be taken in a Tea-cupful of White-wine, Cyder, or small
Punch,

Punch, must have greatly impaired the Strength of it, and rendered it much less effectual (although less offensive to the Stomach) than otherwise it would have been.

28. A Spoonful of *West-India Rum* mixed with the same Quantity of Lime-water, produces a Liquor of a fine Limon-colour, both tasting and smelling strong of the Lime. A little Vinegar added to this, immediately changes its Colour, and destroys all Taste of the Lime.

Rum, in which so much *Limon-peel* had been infused as to give it a yellow Colour, being mixed with an equal Quantity of Lime-water, acquired a stronger yellow Colour; but immediately became turbid; which was owing, I suppose, to the Change made by the Action of the Lime-water upon that Oil with which the Limon-skins abound, and to which the yellow Colour of the Rum was owing.

29. Equal Parts of *French Brandy* and Lime-water produce a Liquor higher coloured than the Brandy was before, but tasting strong of Lime. In an Hour or two there falls to the Bottom a brown Sediment, (especially if the Brandy was high-coloured), and the Liquor above becomes of a Limon-

E

colour,

colour, not tasting of Lime; but when the Sediment is stirred up, it tastes as before.

Much the same thing happens to *Malt-spirits* and *Rum*, when mixed with Lime-water; and in proportion as these Spirits are more or less free of Colour, so is the Sediment that falls to the Bottom. From this we see, that though these Spirits do not destroy the Taste of Lime-water, yet they have a Power of making the Lime precipitate in a short time, which, when it falls to the Bottom, carries along with it whatever is mixed with these Spirits in order to colour them.

30. Having infused a Piece of *B*, two Grains, in one Part *Malt-spirits*, and two Parts Oyster Lime-water; in thirty five Hours warm Digestion its Surface was become white, and it had about one third of a Grain of its Substance dissolved.

From these Experiments we may conclude, that if such Persons as drink Lime-water, cannot confine themselves to watery Liquors, it will be safer to allow them a little weak Punch made without Acids than Wine, Ale, or any fermented Liquors.

S E C T.

S E C T. VI.

Experiments with Lime-water and animal Food, also Milk, Honey and Sugar.

31. I put a Piece of *B*, six Grains, in a Mixture of one Part *Mutton-broth* and two Parts Oister Lime-water, which, after three Days warm Digestion, had two Grains of its Substance dissolved.

32. At the same time having added half an Ounce of a strong Decoction of fresh *Cod-fish* to an Ounce and a half of Oister Lime-water, I immersed in it a Fragment of *B*, four Grains, which in the same Heat was in three Days and twelve Hours reduced to one Grain.

Hence we may conclude, that animal Food may be allowed to such as are under a Course of Lime-water for the Stone.

33. A Fragment of *B*, near five Grains, being put in a Mixture of one Ounce of *Milk* and four Ounces of Oister Lime-water, after digesting forty two Hours in a Heat rather greater than that of the human Body, had some of its Substance dissolved under the Appearance of white Scales, and the great-

est Part of it was become rotten, so as to crumble down upon pressing it with one's Nails.

34. Having dissolved two Drams of *Honey* in three Ounces of Oyster Lime-water, I digested in it a Piece of *B*, five Grains, fifty six Hours in a moderate Heat; it lost only one Grain of its Weight, and what remained was as hard as ever.

35. I immersed a Piece of *B*, five Grains, in three Ounces of Oyster Lime-water, in which was dissolved two Drams of white *Sugar*; in forty eight Hours warm Digestion, it was reduced to three Grains; and what remained did not seem quite so hard.

Thus it appears, that *Honey* destroys in a good measure the dissolving Virtue of Lime-water, while the same Quantity of *Sugar* weakens it but very little. As in mixing Lime-water and *Honey* together, a pretty disagreeable Smell arises, they seem to suffer some Change in their Nature, by which the Virtue of the Lime-water is much weakened. This may be also in part occasioned by the active Particles of the Lime-water being inviscated and sheathed by the balsamick Parts of the *Honey*.

S E C T. VII.

Experiments with Lime-water and several Fruits, Herbs and Roots.

THAT such a Diet may be ordered for calculous Patients as will least destroy the Virtue of Lime-water; after the Experiments upon animal Food, we shall relate the Effects of different vegetable Substances upon it.

36. I infused a Fragment of *B*, eight Grains, in half an Ounce of Juice of *Strawberries*, and two Ounces and an half of Oister Lime-water; after four Days warm Digestion, and seven Days cold, it had lost none of its Weight, nor was there any Appearance of Dissolution about it.

37. I digested a Piece of *B*, six Grains, in half an Ounce of Juice of *Cherries* and three Ounces of Oister Lime-water, six Days warm; but its Surface was neither softened, nor its Weight diminished.

38. A Fragment of *B*, six Grains, being put in a Mixture of one Ounce of a strong Decoction of *Raisins* and three Ounces of Oister Lime-water, was not any way changed by three Days warm Digestion.

From these Experiments we may infer, that all Fruits which have any Acidity or Sharpness, whether fresh, as Gooseberries, Strawberries, Cherries, Apples, Pears, Plumbs, Peaches, &c. or dried, as Raisins, Prunes, Currants, &c. ought to be abstained from by such as use Lime-water with a View to the Dissolution of the Stone.

39. I infused a Fragment of *B*, five Grains, in one Ounce of a Decoction of *Asparagus* and two Ounces of Oister Lime-water; in few Hours its Surface began to turn white, and, in thirty six Hours warm Digestion, it had thrown off, in white Scales, a full Grain of its Weight. As the grosser Parts of the *Asparagus* fell always to the Bottom of the Glass, it was necessary to keep the *Calculus* suspended in the Middle of the Mixture, by means of a Thread, otherwise the Dissolution does not succeed quite so well.

Artichokes seem to destroy the Virtue of Lime-water a little more than *Asparagus*.

40. A Piece of *B*, nine Grains, by digesting warm, four Days, in one Ounce of a Decoction of *Turnip*, and two Ounces of Oister Lime-water, lost more than a Grain.

41. A Fragment of *B*, three Grains, being put into a Mixture of a Decoction of *Parsley* and

and Lime-water, in the above Proportion; in three Days warm Digestion was reduced to one and one fourth Grain, having thrown off the rest in whitish Scales.

42. In an Ounce of Decoction of *Onions*, and two Ounces of Oister Lime-water, a Piece of *B*, of seven Grains, lost, by thirty six Hours warm Digestion, one Grain.

43. Juice of *Lettuce* mixed with Lime-water destroys its Virtues rather more than any of the above.

44. A Fragment of *B*, nine Grains, in *Unc.* i. of a strong Decoction of *Althea Root*, and two Ounces of Oister Lime-water, had, by two Days and eighteen Hours warm Digestion, above a Grain of its Substance dissolved, and a good Part of the rest rotten and friable.

45. I put a Piece of *B*, fourteen Grains, in Oister Lime-water, in which some *Juniper-berries* had been infused; which, in two Days and a half, had above two Grains dissolved.

Green and *Bohea Tea* infused in the same Manner do not considerably destroy the Virtue of Lime-water.

I might have tried the Effect of a great many more vegetable Substances upon Lime-water,

water, had I not been afraid of swelling this Paper to too great a Bulk; but, from these few Experiments, it is probable, that most of the following Vegetables may be safely used by such as drink Lime-water, *viz.* Artichokes, Asparagus, Spinnach, Lettuce, Succory, Parsley, Purslane, Onions, Leeks, Cellary, Turnip, Carrot, Potatoes, Radishes, Green Pease (c).

S E C T. VIII.

Experiments with Lime-water and several Medicines

46. HAVING dissolved *Tartar solubilis drach. i.* in Lime-water *Unc. i. sem.* I put in it a Piece of *B*, four Grains, which, though kept in warm Digestion five Days and a half, had not lost any thing of its Weight, but was become somewhat more friable.

47. I

(c) The Juices and Decoctions of *Onions, Leeks, and Cellary*, are observed to have a very considerable Power of dissolving the softer kind of Gravel stones; and therefore ought to be preferred to most other Vegetables for the Diet of calculous Persons. Vide *Hales's Staticks, Vol. 2.* and *Rutty's Experiments on Mrs. Stephens's Medicines.*

47. I digested a Piece of the same *Calculus* of four Grains in a Solution of *Nitre* in Oister Lime-water, in the above Proportion, which, in five Days and twelve Hours, had near one Grain of its Substance dissolved.

48. Having immersed a Fragment of *B*, seven Grains, in Oister Lime-water *Unc. iii.* *Sal Cathart. amar. drach. i.*; after near four Days warm Digestion, the *Calculus* had scarcely lost any of its Weight, but its external Surface was softer, and somewhat rotten.

49. At the same time I put a Piece of *B*, six Grains, in Oister Lime-water *Unc. ii.* in which was dissolved *Sal Glauber scrup. ii.*; after being kept near four Days in a moderate Heat, its Surface was rather more rotten than the *Calculus* in the last Experiment, but it had lost none of its Weight.

50. A Piece of *B*, six Grains, by digesting warm in Oister Lime-water *Unc. iii.* *Sea Salt drach. i.* betwixt three and four Days, had a Grain of its Weight dissolved.

Lime-water does not remarkably dissolve most of the above Salts, for the greatest Part of them, after standing a little, falls to the Bottom; upon which account I kept the *Calculus* in these Experiments suspended in the Middle of the Phial by a Thread.

Hence

Hence we see, that Salts, even those of the neutral Kind, destroy considerably the Virtue of Lime-water.

51. I put a Piece of *B*, four Grains, in a Solution of seven Grains of *Aloes*, in Oyster Lime-water *Unc.* ii. ; which, by thirty six Hours warm Digestion, was reduced to about three Grains.

52. I infused *Pulv. Rhæi gr.* x. in Oyster Lime-water *Unc.* iii. for twelve Hours ; after which I immersed in it a Piece of *B*, six Grains ; in thirty two Hours warm Digestion, near two Grains of it were rotten and dissolved.

It is observable that Lime-water, mixed with Powder of Rhubarb, immediately acquires a deep red Colour, as if Cochineal had been infused in it ; and the same thing happens when an Infusion of Rhubarb is mixed with stale Urine or Potash ; whence we may see why the Urine of a Person who has taken Rhubarb acquires a bloody Colour if it remains but ever so short a time in a Pot, which is crufted with the Sediment of stale Urine. A *Phænomenon* which, doubtless has discomposed not a few who were ignorant of its true Cause.

53. Having

53. Having infused in the same Manner *Pulv. Jalap. gr. x.* in Oister Lime-water *Unc. iii.* I put in a Fragment of *B*, six Grains, which, by digesting warm thirty two Hours, was reduced to five Grains.

54. A Piece of *B*, four Grains and a half, being for thirty four Hours digested warm, in an Infusion of *Senna drach. sem.* in Oister Lime-water *Unc. iii.* lost one Grain.

55. Having dissolved *Manna scrup. ii.* in Oister Lime-water *Unc. ii.* I immersed in it a Piece of *B*, four and a half Grains; which, by being kept thirty four Hours in a moderate Heat, had above a Grain of its Substance rotten and dissolved.

From these Experiments we see, that if, by drinking Lime-water, the Body should be rendered costive, which (especially if no Soap is taken along with it) may sometimes be the Case, it will be better to use some of the last mentioned Purgatives, than any of the Salts in the Beginning of this Section.

S E C T. IX.

Experiments shewing the Change made on Lime-water by boiling, and being exposed to the open Air, with further Observations on its Nature and Use in several Diseases.

HAVING in the above Sections made a Variety of Experiments with Lime-water upon different Substances, it seemed next very proper to try what Alteration would happen to it from boiling, or exposing it to the open Air, and to inquire wherein its Virtue consists.

56. Twelve Ounces of Lime-water being boiled pretty quickly into four, had lost some of its Virtue; for whereas, before boiling, a blackish Colour was produced by two Parts of it to one of Claret, now it required near two and a half.

57. If a Bottle be filled with Lime-water, and closely stopt, it will keep, for a long time, without suffering the least Change, or losing any of its Virtues: But, having exposed four Ounces of it in an open Vessel, it began very soon to throw up a Scum, and let fall some Sediment of the same Nature; in three Days it had lost most of its fiery Taste, and ceased

to turn Claret blackish ; and in five Days, when the Taste of the Lime was almost quite gone, it neither changed the Colour of Syrup of Violets, nor had any Effect in dissolving the Stone. And this happens equally soon, when placed in the cold Air, as in a moderate Heat ; but depends a great deal upon the Narrowness or Wideness of the Vessel : For it will be found, that the Time in which Lime-water, thus exposed, loses its Virtue, will be more or less, according to the Proportion which the Surface bears to the Quantity of the Fluid.

Since Lime-water, when thus exposed, continues to change the Colour of Syrup of Violets near two Days after it has ceased to have any Effect upon Claret, this last seems to be the severest Test of its Goodness.

The Scum which Lime-water, exposed to the Air, throws up, is at first an extremely thin Pellicle, exhibiting various Colours like a Rainbow, or Soap Bubble ; these Colours, however, gradually change, till, by the constant Apposition of new Particles, the Scum becomes thick enough to reflect all the Rays of Light equally, and so appears white.

This icy Scum or Crust which Lime-water affords, being well beat, and mixed with Sy-

rup of Violets, and then some common Water added to it, the Mixture after a little standing acquires a green Colour. Hence at first Sight it would seem probable, that some Part of the Virtue of Lime-water consists in this Scum; the Parts of which are so minutely divided, and intimately mixed with the Water in its Ebullition with the Quick-lime, as to be absolutely invisible, and to remain inseparable from it, as long as it is kept in a close Vessel. Why they should immediately begin to separate from the Water, and unite together when exposed to the open Air, may perhaps not be easy to account for: Possibly some very active fiery Parts may thus be allowed to fly off from the Lime-water, which before hindered the Union of those earthy Particles, of which this Scum is composed.

Here it may be worth while to observe a considerable Analogy between some Mineral Waters and Lime-water. Chalybeat Waters are, when exposed to the Air, observed soon to let fall a yellow Ocre, and lose their Virtues; and Lime-water exposed in the same Manner soon throws up an earthy Scum, and becomes effete. — Lime-water, boiled in open Vessels, or distilled in close ones, loses a good deal

deal of its Strength ; and the same thing is still more remarkable in Mineral Waters.

It has been a common Opinion, that while the martial Spirit (as it is called) remains in Chalybeat Waters, their metallick Particles continue invisible, but that no sooner does this Spirit fly off, than these Particles begin to unite and shew themselves in the Form of a yellow Ocre. And is it not probable that when Lime-water is exposed to the Air, it soon becomes deprived of some active volatile Matter, which kept its earthy Particles from uniting, and to which its Virtues were in a great measure owing ? The subtile Matter, however, or Spirit of Mineral Waters, is not so easily hindered from flying off as that of Lime-water, since the closest stoppt Bottles do not prevent its Escape, if the smallest Quantity of Air is left between the Water and the Stopper. But to return,

The calcarious Matter which separates from Lime-water upon its being exposed to the Air, can by no Art be again dissolved in Water, or intimately united with its Particles, but perpetually falls to the Bottom, in the Form of a white Powder ; which is altogether insipid, and void of Taste. And upon this account, I suppose, it has gene-

rally been looked upon as a fine flaked Lime; though, from the following Experiments, it will appear, that it differs both from flaked and unflaked Lime.

(1.) Calcined Shells fresh from the Fire, make but a small Ebullition with Vinegar, and send forth a disagreeable sulphureous Smell.

(2.) Calcined Shells that had lain in Water till they were thoroughly flaked, when dried, and reduced to a Powder, did not effervesce with Vinegar at all.

(3.) The calcarious Matter afforded by Lime-water upon Evaporation, being mixed with Vinegar, a strong Ebullition ensues, which lasts for a considerable Time.

(4.) I put a small Quantity of this Powder of Lime-water in a Silver Spoon, and kept it over a pretty brisk Fire for fifteen Minutes; but, after it was taken from the Fire, and cooled, it raised the same Effervescence with Vinegar as before.

(5.) I poured boiling Water once and again upon some of this calcarious Matter, to see if, by repeated *Affusions* of the Water, it would lose any thing; but, after the Water was drained off, and the Powder moderately dried, it effervesced with Vinegar equally as before.

Hence

Hence the Ebullition which the calcarious Matter of Lime-water makes with Acids, seems neither to be owing to a volatile nor fixed alkaline Salt; for a volatile Salt would have been expelled by the Fire, and either a fixed or volatile one dissolved by repeated *Affusions* of boiling Water.

(6.) Powdered Chalk makes a considerable and lasting Ebullition with Vinegar, in the same manner as the Scum of Lime-water, and continues to do so, after repeated *Affusions* of boiling Water, or being exposed to the Heat of a brisk Fire.

Hence the calcarious Matter afforded by Lime-water seems to be a true *alkali terreux*, like Chalk, and its Effervescence with Acids to be owing to this alone.

(7.) Although Quick-lime makes but an inconsiderable Ebullition with Vinegar, and flaked Lime none at all, while the calcarious Matter of Lime-water makes a strong and lasting one; yet all three raise a prodigious Effervescence when mixed with the stronger Acids, as Spirit of Nitre, or Spirit of Sea-salt. Hence all of them seem to partake a good deal of the *alkali terreux*, although this is strongest in the Scum of Lime-water.

Dr. *Langrish* has found, that an *English* Pint of strong Stone Lime-water, made by pouring the Water three different times upon Quick-lime, afforded, upon Evaporation, sixteen Grains of a calcarious Substance (*d*). Now, if we suppose this Lime-water to have exceeded in Strength, our Stone Lime-water, mentioned N^o 21. above, in the same Proportion as the double Oyster-shell Lime-water B exceeded A, which was made by pouring the Water only once upon the calcined Shells (*e*), its specifick Gravity must have been to that of Water, as 286 to 285. Hence, supposing an *English* Pint of Spring-water to weigh exactly one Pound Apothecaries Weight, the same Quantity of Dr. *Langrish's* strong Lime-water would have weighed one Pound and $27\frac{1}{2}$ Grains; wherefore there must have evaporated, along with the aqueous Particles of this Lime-water, $11\frac{1}{2}$ Grains of some subtile Matter, to which its superior Gravity is in part to be ascribed, and to which its Power of dissolving the Stone seems chiefly to be owing; since the calcarious Scum and Sediment can have little, if any, Virtue this way. This subtile active Matter, by Distillation as well

(*d*) Physical Exper. on Brutes, p. 11.

(*e*) Vid Sect 3. No. 21. above.

well as Evaporation, flies off from the Water, so as not to unite with it again, and seems to vanish, or escape through the luting or perhaps even the Pores of the Vessels; for Dr. *Langrish*, upon distilling a Pint of Lime-water from two Quarts, found, that both the distilled Water in the Receiver, and what remained in the Retort, were impaired in their Virtue.

58. Lime-water, when mixed with Vinegar, in the Proportion of ten to one, does not throw up any Scum; but when it has all evaporated in a moderate Heat, leaves a dark-coloured Sediment; which seems however chiefly to arise from the Vinegar.

59. It has generally been thought, that no Salt could be got from Lime-water; nor could I by evaporating it ever procure any; the Scum left behind having rather the Appearance of a fine Lime, or absorbent Earth. If it be said, the Salt in Lime-water is of the volatile kind, and therefore not to be got by Evaporation, it may be sufficient to answer, that, then, this volatile Salt which should in some Degree affect our Smell, ought to be procured by distilling Lime-water in close Vessels: But it is so far from being true, that there is any volatile Salt in Lime-water, that the Vapour which rises
from

from Water, during its Ebullition with Quicklime, is entirely devoid of the Virtues of Lime, and scarcely differs from Common-water. Yet, upon adding one Part White-wine Vinegar to ten or twelve Parts Stone Lime-water, after some Days, I perceived some saline Concretions adhering to the Sides of the Glafs: These tasted not unlike Sea-salt, but sweeter, and, no doubt, proceeded from the acid Salt of the Vinegar rendered neutral by the Lime-water: Having infused a Fragment of *B* in some Oister Lime-water, made with Shells that had lain fifteen Hours after being taken from the Fire, I was surpris'd to observe, in three or four Days, a prodigious Number of small-pointed Crystallisations, like fine Needles, about the sixth Part of an Inch long, darting as it were into its Surface, and giving it somewhat the Appearance of a Hedgehog. But I am apt to think, that these did not proceed from the Lime-water, but the Sea-salt, with which the Oister-shells, even after Calcination, so much abound (*f*). And accordingly I have since often observed the same saline Crystallisations, tho' not so remarkable, produced by Lime-water made with Oister-shells newly got from the Sea; although as far as I remember, never

(*f*) See No. 67. below.

ver from Stone Lime-water, nor that made with calcined Shells, which, by being long exposed to the Weather, had been entirely deprived of their Sea-salt. We are told indeed, that Mr. *Lewenhoëck* discovered, by his Microscopes, in Lime-water, a great Number of saline rigid Particles (*g*). But whether his Imagination assisted him herein, or whether he did not rather want to discover a Similitude betwixt this Water and that got off burnt *calculi*, and the tophaceous Matter which sometimes issues from the Joints of gouty Persons; or whether there really are such saline Particles, I will not take upon me to determine: For altho' it has been the general Opinion of the most eminent Chymists, that no Salt could be procured from Quick-lime; yet, of late, Mr. *Du Fay* pretends to have extracted a Salt from Lime-water, and has given an Account at large of the Way in which this may be done (*b*). But, since his Salt is of the neutral kind, and does not seem to be possessed of any remarkable Virtues; and since he observes, that, unless the Lime-stone is put red hot into the Water, and boiled with it, and its Water poured out while it is yet boiling in order for

Evaporation,

(*g*) Musgrave de Arthritide, cap. ix. § 4.

(*b*) Memoires de l'Acad. des Sciences 1724.

Evaporation, it either affords no Salt at all, or very little; we may safely conclude, that the Virtue of Lime-water does not lie in this Salt. And as the calcareous Substance which, upon Evaporation, it deposites, has little Efficacy, and seems scarcely any thing different from a mere absorbent alkaline Earth, it remains, that the dissolving Virtue of Lime-water is owing to some very active penetrating subtile Matter, which the Water, during its Ebullition with the Quick-lime, is impregnated with, and to which the Increase of its specifick Gravity is partly to be ascribed; but which, upon Lime-water's being exposed to the Air, soon flies off, and leaves it effete.

60. Altho' Lime-water changes the blue Colour of Syrup of Violets into green, and affords an alkaline absorbent Earth, which effervesces with, and destroys Acids; yet as the Water itself does not effervesce with Vinegar or Spirit of Vitriol, it seems to partake but little of an alkaline Nature. Nor do the Virtues of Quick-lime consist in an *Alkali*: For Quick-lime effervesces much less with Vinegar than with Small-beer, and is very difficultly flaked by either; while Water, which is neither acid nor *alkali*, being poured upon it, produces great Ebullition and Heat, and quickly

ly dissolves it. And altho' Quick-lime makes a great Ebullition with the stronger Acids, as Spirit of Vitriol, Nitre, and Sea-salt; yet this arises from the terrestrious *Alcali* which it contains in common with slaked Lime, the Scum of Lime-water, and the other Absorbents, and not from any particular Salt of that Nature. Nor is the Activity and corrosive Power of Quick-lime owing to its alkaline Nature; since the calcarious Matter of Lime-water, which is insipid, and altogether void of the peculiar Taste of the Lime, makes a greater Effervescence with Vinegar than it, and since Mr. *Homburg* has observed that slaked Lime requires as much Spirit of Nitre, or Sea-salt to saturate it as Quick-lime (i).

The drinking of Lime-water does not render the Urine alkaline; for Mr. *Millar's* Urine neither effervesced with Vinegar, nor turned Syrup of Violets green; altho' he alledged he could perceive the Taste of the Lime-water in it. Nor does Quick-lime itself change any of the Humors of our Body into an alkaline Nature. Upon adding it indeed to Urine, a fiery pungent Vapour arises; which, however, is not properly alkaline; for being mixed with Acids, no Effervescence ensues, though its
fiery

(i) Memoires de l'Acad. des Sciences an. 1700.

fiery Nature and Volatility are greatly diminished by them. Nor has any Art yet been able to procure from this Spirit the smallest Quantity of Alcaline, or indeed of any other Salt (*k*).

From this it is evident, that the strong-scented alkaline Urine voided by such Persons as have taken Mrs. *Stephens's* Medicines, is not so much owing to the Lime in them, as to the alkaline Salt or Potash, which makes up so considerable a Part of the Soap. And the dissolving Virtue of such Urine does not seem to consist (as Dr. *Kirkpatrick* and the *French Academists* think (*l*) in its alkaline Nature; since we find in Mr. *Millar's* Urine this Power without that Quality; and since Dr. *Hales* has shown, that the Potash, which is almost the only alkaline Ingredient in these Medicines, has little Effect in dissolving the Stone (*m*).

Altho' Quick-lime appears, by its Effects, to have a very considerable Affinity with fixed alkaline Salts, yet in many respects it differs from them; and there are not wanting Experiments which seem to indicate an acid Quality

(*k*) Boerhaave *Chemia*, Vol. 2. Procef. 97.

(*l*) *Kirkpatrick's Case*, and *Memoires de l'Acad. des sciences*, an. 1739 & 1740.

(*m*) See below, No. 62.

ty in it. Hence several chymical Writers have been of opinion, that Quick-lime contained both an acid and a fixed alkaline Salt, and to the Conflict between these opposite Salts they have ascribed the Ebullition and Heat which is produced when Quick-lime is dissolved by pouring Water upon it (*n*). Nor is it any Wonder, say they, that, by the Affusion of Water, no Salt is got from Quick-lime, because its two opposite Salts are, by acting on each other, destroyed, and turned into a third Substance, which, like all Magisteries, is insipid, and not dissolvable in Water (*o*).

Lime-water being mixed with Salt of Tartar, immediately becomes turbid and whitish, and after some time lets fall a white insipid Powder; which is not a vitriolated Tartar, as Mr. *Malouin* alledges, (*p*) but greatly resembles prepared Oyster or Egg Shells; for it is an absorbent alkaline Earth which effervesces strongly with Vinegar and Spirit of Vitriol, but is not dissolved by the latter. If ten Grains of Salt of Tartar are added to three Ounces and a half of Lime-water, after the above mentioned Powder

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has

(*n*) Mayow oper. cap. 14. de æstu calcis vivæ.

(*o*) Idem. ibid.

(*p*) Macquer elemens de chymie theorique p. 67.

has precipitated, the Water has a bitter Taste from the alkaline Salt ; but when an Ounce and a half more of the Lime-water is added, the Liquor becomes much less bitter, and gets a good deal of the Taste of Lime-water.

When Lime-water destroys Acids, we readily ascribe this Effect to the alkaline Earth which it contains : But to what Principle in Lime or Lime-water are we to refer the Precipitation which happens upon the Mixture of Lime-water with a fixed alkaline Salt ? Does it shew that there is an Acid in Lime-water ? that this Acid is united closely with an alkaline Earth, which it keeps invisibly suspended in the Water ; but that being strongly attracted by the fixed alkaline Salt, it leaves this Earth, which then precipitates in the Form of a white Powder ? Are we to ascribe it to this Acid, that Spirit of *Sal ammon.* distilled with Quick-lime, has its Nature so changed, as not to effervesce with Acids ? Does it seem probable that certain Stones and animal Shells are, by Calcination, changed into Quick-lime, because, as alkaline Earths, they are peculiarly qualified to receive and unite with this Acid ? And may we conclude from the above Experiment, that the active Properties of Quick-lime are owing to an

an alkaline Earth heightened, perhaps, by the Fire, and united with a subtile acid Spirit? Whoever should answer these Queries in the Affirmative, would be greatly too hafty in his Conclusions; for the following Experiment will shew, that though fixed alkaline Salts render Lime-water turbid, and cause a Precipitation, yet their alkaline Quality is no way destroyed by it.

Having added forty Grains of Salt of Tartar to twenty Ounces of strong Stone Lime-water, after some Hours, I poured off the clear Water, and boiled it into three Ounces and a half; when it effervesced strongly, both with Vinegar and Spirit of Vitriol. Further, if there was an Acid in Quick-lime, would a Solution of Potash have its pungent corrosive Qualities greatly heightened by being poured upon it? Ought not rather its alkaline Nature to be thence greatly impaired or destroyed?

Mr. *Geoffroy* thinks, that there is in Quick-lime a fixed alkaline Salt, formed of the aluminous, vitriolick, or nitrous Acid of the Stone, and of the Acid in the Wood or Coals (9).

This Salt he imagines to be, like the fixed

G 2

alkali,

(9) *Memoires de l'Acad. des Sciences 1720, Edit. 8vo, p. 28.*

alkali, united with Flint and Sand in making Glass, so intimately conjoined with the earthy Parts of the Lime, as not to be separable from them by any Affusion of Water. But if this be so, it must be allowed that Lime-water cannot owe its Virtues to this Salt; nor by Consequence Lime itself, whose Virtues are of the same kind, tho' vastly stronger. If it be said that Lime-water contains some of the finer Parts of the Lime, to which its Virtues are owing; we answer, that as the calcareous Matter which Lime-water affords, is a mere alkaline Earth, the supposed Salt must have left it, and consequently cannot be so inseparably united with the earthy Parts of the Lime, as is supposed. Further, as Quick-lime, after being rendered almost insipid by frequent Affusions of Water, acquires its former Properties, by a new Calcination (*r*), it evidently follows, that no peculiar Salts are required in animal Shells, Stones, or Chalk, in order to their being changed into Quick-lime by Calcination.

Nay, if Lime-stone be, before Calcination, impregnated with alkaline, acid, or neutral Salts, it will not, by being burnt in the most intense

(*r*) Memoires de l' Acad. des Sciences 1700, Edit. 8vo, p. 160; et Macquer elemens de chymie theorique, p. 66.

intense Fire, acquire the Properties of Quick-lime (s).

Since, then, there does not appear any good Reason to ascribe the Virtues of Quick-lime or Lime-water to any acid or alkaline Salts; it may be asked, what is the Nature of Quick-lime, and whence do its active Qualities proceed? To which I answer, that it is an alkaline Earth, which acquires, by Calcination, highly acrid, penetrating, and igneous Properties; and that, as the native Salts of Vegetables are, by the Action of the Fire, converted into a fixed alkaline Nature, so the earthy Matter of animal Shells, and certain Stones, is, by burning, changed into an active fiery Substance, which, however it may agree, in some Things, with these Salts, differs from them in many Respects, and is of a Nature peculiar to itself.

Whether the active Properties of Quick-lime are owing to the Element of Fire, being closely united with, and as it were concentrated in its earthy Matter; or whether they are not rather to be ascribed to some new Change made on this Matter by the Action of Fire, I shall not pretend to determine: Only, as Air is attracted by the Bodies of

G 3

Animals

(s) Macquer *elements de chymie theorique*, p. 68, &c.

Animals and Vegetables in considerable Quantities, and deprived of its Elasticity, while intimately united with their minute Parts (*t*): So, may not the Particles of Fire be received into Lime-stone and Shells, while they are calcining; and there remain, as it were, fixed and unactive, till they are set loose by the Dissolution of the Parts of the Lime, upon the Affusion of Water (*u*) or some other *Menstruum*?

All acid and acescent Liquors as Vinegar, Wine, &c. seem to destroy the Virtues of Lime-water, not merely by depriving it of the small Degrees of *Alcali* it possesses; for as Dr. *Hales* has found several Bodies remarkable for absorbing or destroying elastick Air, fo

(*t*) *Hales's* Statical Essays, Vol. I. Chap. vi.

(*u*) This was Doctor *Willis's* Opinion, who thence explained the Ebullition, which happens when Water is poured on Quick-lime; but it must be owned that, for ought we know, this Ebullition may be, in a great measure, owing to the entire Expulsion of all Humidity out of the Lime-stone and Shells by Calcination; for when boiling Water is poured on Coffee-beans, fresh burnt and ground, a like Ebullition ensues; which, however, can with no Colour of Reason, be ascribed to any concentrated Fire; and the same thing is true of the violent Ebullition and Heat, that are occasioned by the Mixture of Water and Oil of Vitriol.

so it is not unreasonable to suppose, that there may be others, which have the same Effect upon Fire; and that acid and ascendent Liquors which are potentially cold, have it most remarkably.

61. From the great Affinity which has been generally supposed, by Medical Writers, betwixt the Gout and Gravel, it might perhaps be worth while to try the Effects of Lime-water in this Disease also. And the learned Dr. *Cheyne* having asserted, that the gouty Chalk-stones and Gravel Stones were, as to all their essential Qualities, the same, and that they yielded both the same Principles, when chymically treated (*x*), I procured some of them, and infused them in Lime-water. At first, being specifically lighter than the Water, they swam. But, after emitting a great Quantity of Air-bubbles, they soon fell to the Bottom, and, in a Day or two, were become as soft as Butter. But, having afterwards infused a Piece of this gouty Matter in Common-water, I found precisely the same Effects from it as from the Lime-water: So that whatever Probability there may be of Lime-water doing Service to gouty People, from the supposed Affinity betwixt it and the
Gravel,

(*x*) *Cheyne* on the Gout, p. 72. Edit. 4

Gravel, yet nothing can be drawn from this Experiment. However, Lime-water promises to do as much, as an Alterative, in several chronical Diseases, as many other Medicines. It may be taken in large Quantities, and be long persisted in. Its Parts are so subtile, that they can penetrate, at least, where-ever Water can go (y); and, consequently, must pass through the smallest Vessels in the human Body. When mixed with the Blood or Urine, it seems to exalt their Salts and Oils, and upon the Solids it acts partly as an Astringent. Hence it ought to be of use where the Blood is watery, sluggish, viscid, and unactive, and the Solids weak or relaxed. In the *Fluor Albus* and *Diabetes* its Virtues are conspicuous; and it promises to do more in the *Scrophula* than most Medicines. In *Diarrhæas* and *Dysenteries* from Acidities in the *Primæ Viæ*, and in Excoriations, or Ulcerations of the Guts, it is an excellent Remedy. From its penetrating, dissolving (z) and detergent Qualities, there is Reason to expect Benefit from its Use in chronick Rheumatisms, the *Sciastica* and other Obstructions in the smaller Vessels.

(y) See No. 57, above.

(z) Lime-water mixed with Blood, not only preserves it in a fluid State, but dissolves it when newly coagulated.

Vessels. I have been told of its having had good Effects in low nervous Fevers: But in ardent and putrid Fevers it ought to be hurtful, on account of its Power of volatifying the Salts, and corrupting the Oils of the animal Humours. In the Scurvy it sometimes proves a sovereign Remedy, at other times fails. I once cured a wet scorbutick Eruption on the Hands, after a mercurial Salivation had been found ineffectual, by causing the Patient drink above an *English* Pint of Oyster-shell Lime-water every Day for two Months, and now and then wash her Hands with it.

S E C T. X.

Experiments with Lime-water, Soap-leys, Soap, &c.

IT appearing from Dr. *Hales's* Experiments, that Soap is possessed of a considerable Power of dissolving the Stone, and that this is chiefly owing to the Lime that enters into its Composition, I was excited to make some Experiments upon it, with a View still further to discover wherein its Virtue lay, and what Proportion it bears to that of Lime-water; whether Lime-water might not be improved by it; and how far their lithon-

triptick

triptick Quality is destroyed by the same Things.

62. Having dissolved *Potash drach. ii. sem.* in boiling Water *Unc. iv.* I put in it a Piece of *A*, weighing nine Grains, which, in fifteen Days warm Digestion, lost very little of its Weight, nor was its Surface softened to any Depth. However, its Substance seemed to have been rendered more friable; for, upon pouring boiling Water upon it, it rent in several Places.

63. I boiled Stone Lime-water *Unc. xiv.* with *Potash drach. v.* into *Unc. vi.* and having laid a Piece of *A*, of eleven Grains and a half, in it, found, that, after standing twelve Days in a gentle Heat, it had lost seven Grains and a half of its Weight.

64. A Pound and a half of boiling Water, in which an Ounce of *Potash* was dissolved, being poured on two and a half Ounces of *Quick-lime*, afforded, after the Ebullition was over, and the *Lime* had fallen to the Bottom, a very fiery corrosive Liquor; which, if applied to the Tongue, in the smallest Quantity, was in hazard of bringing off the Skin. A Piece of *A*, ten Grains and a half, was dissolved in it in fifteen or sixteen Hours, in a moderate Heat. A *Lixivium* of the same kind,

kind, which I made afterwards, but which did not seem so strong, dissolved a Piece of *B*, three Grains, in twelve Hours; while a Fragment of the same *Calculus*, of fourteen Grains, required three Days and six Hours of a cold Maceration in *Aqua fortis simplex* (*a*) to dissolve it.

Does not the great dissolving Power of this *Lixivium* arise from its abounding so much with the fiery Particles of the Quick-lime, which are strongly attracted by the alkaline Salts of the *Potash* (*b*)? And, as Sir *Isaac Newton* has observed, that the Particles of Light are most strongly attracted by sulphureous Bodies, so does there not seem to be a mutual Sympathy or Agreement betwixt alkaline Salts and the Particles of Fire?

Instead of an Ounce I dissolved *drach. ii.* of Potash in *lib. i. sem.* of Water, and poured it on Quick-lime as above, thinking that the *Lixivium* thus procured, would be possessed of a greater Power of dissolving the Stone than simple Lime-water, and at the same time not so fiery as to be in Danger of destroying any
Parts

(*a*) Pharmacop. Edinburgenf. p. 163.

(*b*) As a Proof of this I have observed, that the Strength of it depends in a great measure upon the Quick-lime's being well burnt, and quite fresh from the Fire.

Parts of the human Body; but I soon found, that any Advantage I expected from the greater lithontriptick Virtue of this *Lixivium*, was more than balanced by the extreme Nauseousness communicated to it by the alkaline Salt.

[64.] Having found a much greater Power of dissolving the *Calculus* in Shell than in Stone Lime-water (c), I thought it might be worth while to try whether a Ley made with it and Potash, would prove a stronger Lithontriptick than common Soap-leys. For this Purpose I poured two Pounds of boiling Water upon four Ounces of purified Potash, and five Ounces of calcined Oyster-shells fresh from the Fire, and let them stand twenty four Hours. Then into a Phial-glass filled with this Ley, I put a Piece of *B*, thirteen Grains, which, after ten Hours warm Infusion, was entirely dissolved. At the same time I put another Piece of *B*, of the same Weight, into the common Ley with which they make Soap at *Glasgow*. After sixteen Hours warm Infusion, it was mostly all dissolved into a white Powder; and the very small *Nucleus* that remained, was quite rotten, and, when pressed between one's Fingers, fell down into a white Mucilage.

This

(c) See above, No. 14—18.

This Ley, made with Oister-shell Lime, was neither so corrosive nor disagreeable as the *Glasgow* Soap-leys; for, when mixed with twelve times its Quantity of Water, it was less nauseous, and not more acrid, than the other diluted with sixteen Waters. Its specifick Gravity was one twenty fourth Part less than that of the common Ley. Notwithstanding all which, we see its dissolving Power was above one third stronger.

Hence, in Cases where it is thought proper to order Soap-leys for the Cure of the Stone, it plainly appears, that a Ley of Potash and Shell-lime is preferable; since a larger Quantity of it may be used with equal Safety, and since it possesses a much greater dissolving Power.

While the *Glasgow* Soap-leys, Lime-water and a Solution of Soap, corrode, and break down the *Calculus* into a white Powder, or rotten Scales, and so are, properly speaking, only Lithontriptics, the Ley of Potash and Oister-shell Lime melts down the Stone into an unctuous Substance, which is mostly all suspended in the Pores of the *Menstruum*; which therefore, like *Aqua fortis*, or Spirit of Nitre, may be properly called a Solvent of the Stone.

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When

When a Fragment of *B* was immersed in this Ley, it immediately sent forth from every Part of its Surface small Streams, as it were of an oily Fluid, exhibiting the same Appearance in the Ley, as Rum does when mixed with Water. This may be observed by holding the Phial in which the *Calculus* and Ley are contained, between one and the Light. And though it is most remarkable after the first Immersion, yet it continues, in some Degree, for a considerable Time.

The *Calculus* immersed in the *Glasgow* Ley, did not exhibit any such Appearance, but its Surface quickly became all over white.

To two Ounces of purified Potash, and three and a half Ounces of Oyster-shell Lime, I added twelve Ounces of boiling Water. After twenty four Hours I decanted off the Ley, and poured it upon fresh calcined Shells; by which means it acquired a yet stronger Virtue of dissolving the *Calculus*: For a Piece of *B*, thirteen Grains, was, after eight Hours warm Infusion in it, totally dissolved. Although this Ley dissolved the Stone twice as fast as the *Glasgow* Soap-leys; yet, mixed with equal Quantities of Water, it was less nauseous, and but very little more pungent.

From

From these Experiments, it is reasonable to think, that if the *Sapo Amygdalinus* of the *London Dispensatory* were made with a Ley of purified Potash and Oister-shell Lime, instead of common Soap-leys, it would be full as agreeable to the Taste, and possessed of a greater Power of dissolving the Stone.

65. A Piece of *A*, of seventeen and a half Grains, being put in a Solution of *Alicant* Soap in warm Water, had, after six Days warm Digestion, a pretty thick white Crust all round it ready to fall off; which being removed, the undissolved Part weighed fourteen Grains. In nineteen Days it was reduced to six Grains.

66. It is not so easy as one would at first think, to account for the dissolving Virtue of *Alicant* Soap (*d*): For of its three Ingredients, Lime-water, alkaline Salt, and Oil, only the first has any considerable Power this way, the second having very little, and the third none at all. The first and second mixed together, have not more than the first alone (*e*); and the second and third united, have

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none

(*d*) If, as Mr. Lemery affirms, and I have been informed, it is made only of fixed alkaline Salt, Lime-water, and Oil. See p. 158. above.

(*e*) Compare No. 10. 11. and 12. with No. 63. above.

none at all : And yet of these two last, the Soap chiefly consists. Besides, as Lime-water, when boiled into a Ley with Potash, rather loses than acquires any dissolving Virtue, it is difficult to give a Reason why, after the Addition of so much Oil in making Soap, this Virtue should not be still much more weakened. To account for this, it ought to be observed, that as in boiling Lime-water a Scum is always left behind ; so the vast Quantity of Lime-water that is added to the alkaline Salt and Oil in the making of Soap, must, when evaporated, leave a great deal of the Scum mixed with the other two Ingredients. And as it is probable, that some Part of the Virtue of the Lime-water may remain in this Scum (*f*) ; so, although the watery Humidity in Soap bears but a small Proportion to the other Ingredients (*g*), yet there may be united with them what in some Degree contains the Virtues of a very great Quantity of Lime-water. Besides, I imagine, that the Lime-water used in making Soap is somewhat

(*f*) See No. 57. above.

(*g*) According to Mr. Geoffroy, in 180 lib. of Soap there are only 15 lib. of a watery Humidity. See *Memoires de l'acad. des sciences, anno 1739.*

what turbid, and so must carry along with it some of the grosser Parts of the Lime; which, uniting with the alkaline Salt, must heighten the dissolving Power of the Soap: And this seems to be confirmed by small Bits of Lime, being sometimes found undissolved in Soap. But further, it is probable, that the Lubricity given to the Soap, by means of the Oil, may enable the active Parts of the Lime-water and Potash to enter the Pores, and penetrate more easily into the Substance of the *Calculus*, and thus facilitate its Dissolution. That I might be more fully satisfied of this, I made a Solution of *Alicant* Soap in Stone Lime-water, to see whether the Virtue of the Lime-water might not be increased by its Mixture with the Soap. Nor was I disappointed: For I found this to have a greater dissolving Power than either a Solution of Soap in common Water, or Lime-water by itself, or even than the Aggregate of the dissolving Powers of Soap and Lime-water when unmixed: For a Piece of *A*, eighteen Grains, after lying five Days in it in a moderate Heat, was reduced to six Grains, several white Crusts having fallen off in this Time. Finding it had lost none of its Weight, and that no further sensible Impression was made on its Surface, after standing

twenty four Hours longer, and observing that the Bottle was not very closely corked, I suspected that the Solution had lost its Virtue, which evidently appeared by its having lost all Taste of the Lime-water ; I therefore put the *Calculus* in a new Solution, where in three Days it was all dissolved, except a small *Nucleus* weighing a Grain.

[66.] Another Time, when I made the same Experiment, I did not find the Virtue of the Lime-water so much increased by the Soap : For a Piece of *B*, ten Grains, put into the like Solution, in two Days and nine Hours, only lost a little more than three Grains ; while a Piece of the same Weight, in Stone Lime-water alone, lost in that time two Grains. Whether the Soap in the one Case was better than in the other, or whether the due Proportion in mixing them was not hit in this last Experiment, I cannot positively affirm.

It may be proper to observe, that the Lime-water must be pretty hot ; and the Soap and it must be agitated together for a considerable Time, otherwise they will not unite.

The quick Dissolution of the Stone in the two last Experiments, affords a clear Reason for the Success which attended the Stone Lime-

water

water in Mr. *Millar's* Case; which we ought to consider as having had its Efficacy in a good measure heightened by its being taken along with a considerable Quantity of Soap.

67. Having found the dissolving Virtue of Oister-shell Lime-water much greater than that of Stone-lime, I thought a Solution of Soap in it would have a proportionably greater Effect. But here I was soon disappointed: For I found it impossible by any Art to make them unite; which seems to be owing to the Sea-salt that abounds in the Oister-shells, and which the Fire had not been able entirely to destroy. However, as the Cockle-shell Lime-water (N^o 17.) dissolved Soap, I suspected, that, if Oister-shells were long exposed to the Weather before calcining, the Water procured from them might probably do so likewise. Accordingly having got some that had lain long upon the Sea Shore, and burnt them, I found the Lime-water they afforded mix with Soap as well as any other (*b*): But
neither

(*b*) I boiled some Oister-shells four or five Hours, changing the Water thrice in that Time, thinking that this might free them of their Salt, and render their Lime-water miscible with Soap; but without any Effect. However, I should advise the boiling and washing of these Shells before they are calcined; as it seems to free the Lime-water of somewhat of a fishy Taste it otherwise has.

neither it, nor the Cockle-shell Lime-water, seem to have their Virtue sensibly increased by the Soap.

Are not the Particles of Shell-lime more subtile, saponaceous, and penetrating, than those of Stone-lime? Does not Shell Lime-water partly owe its greater dissolving Power to this? And, because if it is naturally saponaceous and penetrating, is not the Effect of Soap upon it, less remarkable than upon Stone Lime-water, which is more devoid of these Qualities?

[67.] Having poured a very weak Solution of Soap upon some calcined Oyster-shells, I procured a Liquor tasting somewhat of Soap, and strongly of Lime; which, in thirty eight Hours warm Digestion, reduced a Piece of *B*, four Grains, to one and one third Grains.

After this I dissolved three Drams of Soap in thirty five Ounces of boiling Water, and poured it on five Ounces of calcined Oyster-shells. The *Lixivium* which they afforded, tasted strong of the Soap as well as Lime, and was pretty pungent and disagreeable. Being mixed with Urine, it produced the same Appearance as simple Lime-water (*i*); but raised a Smell something like that of burnt
Horn.

(*i*) See No. 8. above.

Horn. A Piece of *B*, three Grains and a half, being immerfed in it, was, in twenty four Hours warm Digestion, reduced to one Grain.

The Strength of this *Lixivium* was probably owing to its abounding with the fiery Particles of the Quick-lime; which are more strongly attracted by the Solution of Soap, (on account of the alkaline Salt in it), than by common Water.

68. A Solution of Soap in fresh Small-beer, had no Effect in diffolving some Pieces of *A*, although allowed to lie eight Days in it, in a moderate Heat.

69. A Solution of Soap, made in one Part of *Scots Aquavitæ*, and two Parts of Water, has very little Virtue, though more than the preceeding.

Thus we see, that the diffolving Power of Soap, as well as Lime-water (*k*) is destroyed by fermented Liquors, and greatly weakened by Spirits; and, consequently, now proper it is for such as use it, to abstain from them.

70. I put a Piece of *B*, seven Grains, in a Solution of *Alicant* Soap; which, by being

(*k*) See No. 24. 25. 26. and 30. above.

being kept in a gentle Heat for four Days, lost two Grains of its Weight.

71. At the same time I infused two Pieces of *B*, each weighing eight Grains; the one in two Ounces of the above Solution, with a Dram of white Sugar; and the other in two Ounces of the same, with a Dram of Honey: The *Calculus* in the Solution with Sugar, lost about two Grains in four Days warm Digestion, while the other was scarcely diminished in Weight above one Grain.

As in refining Sugar a good deal of Lime-water is employed, so it is probable, that some of the more active and subtile Parts of the Lime may adhere to it. And this may be the Reason why it destroys the Virtue of Lime-water less than almost any other Substance, and seems scarce to weaken the dissolving Power of Soap at all.

From this Experiment it appears, how much the lithontriptick Virtue of Mrs. Stephens's Medicines must be weakened, by her ordering the Decoction to be sweetened, and the Pills to be made up with Honey; and that in place of it the *Syrupus de Saccharo* and Sugar may be substituted with considerable Advantage.

72. I infused a Fragment of *B*, five Grains and a half, in a Solution of *Alicant* Soap, made in a strong Decoction of *Asparagus*; which, after digesting warm for five Days, had lost near two Grains.

73. Most People have, doubtless, had Occasion to observe, that while the internal Part of *Alicant* Soap is of a blue Colour marbled with white, its Surface, which is exposed to the Air, is reddish, and sometimes yellow or white. Now, as by the above Experiments we have found, that the stonetriptic Virtues of Soap and Limes-water are in many Instances destroyed by the very same Things; and as Lime-water, by being exposed to the Air, is soon rendered effete, I made the following Experiment, to see if that Part of the Soap, which has its Colour changed by the Air, possesses less Virtue than the rest.

Having dissolved some of the internal bluish Part of *Alicant* Soap in warm Water, I infused in it a Piece of *B*, six Grains; which, in three Days warm Digestion, lost near two Grains.

At the same time, I made a Solution of equal Strength, of the external Part of the same Soap, in warm Water, and immersed
in

in it a Fragment of *B*, six Grains: After digesting fifty eight Hours warm, and fifteen cold, it had only lost about three fourths of a Grain.

α From this Experiment it is plain, that such as swallow Soap for the Stone or Gravel, should carefully throw aside that Part of it which has had its Colour changed by the Air; and as in very old Soap I have seen this about one third of an Inch thick, it is very probable, that two Ounces taken with this Caution will have as much Effect as two and a half, when good and bad are swallowed both together.

β Hence it also appears, how improper it is to make Soap into Pills, unless they are presently to be used; and consequently how much Mrs. *Stephens's* Medicines must have suffered in this way. For, as the Air, in rendering the Soap effete, acts only upon its external Surface, the more the Surface is increased, the greater will the Quantity be that is deprived of its Virtue. Thus, suppose a cubical Piece of Soap of four Inches, made into twelve or fifteen hundred Pills, its Surface, which was before only ninety six, will now, perhaps, be above a thousand square Inches; and consequent-

ly,

ly, in a given Time, the Pills must lose ten times more of their Virtue, than such a Piece of Soap, if allowed to remain whole. Soap seems also to be rendered a good deal the worse when reduced to a Powder; whereby, not only its lithonriptick Power is weakened, by its Surface being thus increased, and exposed to the Air, but the watery and oily Parts of the Soap being mostly evaporated, leave the alkaline Salt very much exalted, and deprived in a great measure of that which was intended to correct it.

γ From this it still further appears, that the dissolving Virtue of Soap lies chiefly, if not wholly, in the Lime that is in it (1); and not in its alkaline Nature, which is not so soon nor so remarkably destroyed by being exposed to the Air.

74. Potash, three Drams, Oil of Olives, five Drams, Stone Lime-water, four Ounces, being mixed, and boiled over the Fire to the Consumption of one half, I put a Piece of *A* in it; but, after standing in a gentle Heat several Days, found no Appearance of its being in a dissolving State.

I

As

(1) See No. 60. and 66. above.

As in this Mixture the Oil was not sufficiently united with the Potash and Lime-water, I imagine the Surface of the Stone being besmeared by it, hindered these from having that Effect they otherwise would have had (*m*).

From the same Cause I fancy it was that Soap-leys and Oil did not dissolve the *Calculus* in one of Dr. *Hales's* Experiments (*n*). He seems, indeed, to think, that, in order to the Soap-leys exerting their Virtue, the Oil must be separated from them ; which he reckons is done in the Course of the Circulation. But, with Submission, I would think it only necessary that the Oil should lose its Nature, so far as to become miscible with Water. Thus we find a Solution of Soap dissolves the Stone, although the Oil be not separated from the other Ingredients of the Soap.

75. Dr. *Hales* having been lately informed, that Oyster-shell Lime-water, mixed with *Spir. Nitri dulcis*, in the Proportion of an *English* Pint of the former to half an Ounce of the latter, was a more powerful Solvent
of

(*m*) See No. 62. above

(*n*) Vid. Experiments on Mrs. *Stephens's* Medicines, P. 31.

of the Stone out of the Body than the Lime-water alone ; in order to know the Truth in this Matter, he added half an Ounce of dulcified Spirit of Nitre to a Pint of Oyster-shell Lime-water, made by pouring a Gallon of Water on a Pound of calcined Shells, and having filled a Phial of two Ounces with this Mixture, he put into it a Piece of a large *Calculus X*, weighing twelve Grains. At the same time he put into a like Phial, filled with the Lime-water unmixed, another Piece of the same *Calculus Z*, weighing eleven Grains. Both these Phials were placed in a Heap of Dung, whose Warmth was ninety four Degrees, according to *Farenheit's* Thermometer.

After forty three Hours, the Surfaces of both these Stones were covered with a white Mucilage, but there was much less of this on the *Calculus X* than on *Z* : the same Difference was observed after sixty three Hours ; but after this it became less sensible. In a few Days after the Phials were taken out of the Dung, the Lime-water unmixed lost its dissolving Power entirely ; but that to which the dulcified Spirit of Nitre was added, continued, for two Months, to turn the Surface

of its *Calculus* to a very thin Coat of white Mucilage.

From this Experiment, which the Doctor was so good as to communicate to me, it appears, that dulcified Spirit of Nitre rather weakens than increases the dissolving Power of Oyster-shell Lime-water; but that this Lime-water mixed with it, retains a lithontriptick Virtue much longer than it would otherwise do. Whether this dissolving Power, which continues so long, be owing to the Lime-water preserved from becoming effete, by the *Spir. Nitr. dulc.*; or, whether it is not rather to be ascribed wholly to this Spirit, which, when mixed with Common-water, dissolves the *Stone* (o), I shall not presume to determine; though the latter Opinion seems most probable.

However, since dulcified Spirit of Nitre does not much abate the Virtue of Lime-water, and is itself possessed of a lithontriptick Power, it may be safely given to Patients who are under a Course of Lime-water for the *Stone*; and as it is a good Remedy for Wind in the Stomach and Guts, provokes Urine, allays Heat and Thirst, prevents

(o) Ratty's Exper. on Mrs. Stephens's Medicines, Sect. IV. cap. 35, and 36.

vents Putrefaction, and restores a depraved Appetite from corrupted Humours, many Cases may occur, where it may be prescribed, to great Advantage, along with the Lime-water.

We have observed above, (N^o 10.) that Lime and its Water volatilise the Salts, and corrupt the Oils of the animal Humours; when therefore we meet with calculous Patients, whose Fluids have a more than ordinary Tendency to Putrefaction, it might be very proper to make them add a few Drops of dulcified Spirit of Nitre to every Draught of the Lime-water.

76. A Piece of *B*, twelve Grains, being infused in Spirit of Sea-salt for near seven Days, the greatest Part of which it was kept in a moderate Heat, had only three Grains of its Substance dissolved.

By comparing this Experiment with those of N^o 17. 18. 19. and [64], it appears, that both Soap-leys and Oyster-shell Lime-water are stronger Dissolvents of the *Calculus* than Spirit of Sea-salt.

If an Ounce of Spirit of Sea-salt be mixed with eight or ten Ounces (*p*) of Spring-water, or Lime-water, and poured upon calcined

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cined

(*p*) According to the Strength of the Spirit.

cined Oyster-shells fresh from the Fire, a great Ebullition and Heat ensues. After this is over, and the Lime quite fallen to the Bottom, a clear Liquor remains above; which being filtered through a Piece of Flannel, is as pellucid, and void of Colour as Water. This Ley has no Smell; but a pretty strong saline, and somewhat pungent Taste, with a small Degree of Astringency. If it retains any thing of the peculiar Smell or Taste of the Spirit of Sea-salt, this shews that the Spirit has not been thoroughly saturated by the Lime. To prevent this, I found it of Use, to mix with the Spirit of Sea-salt and Water, before I poured them on the Lime, a small Proportion of purified Potash, not with a View to saturate the Spirit, but a little to abate its Force, and strong disagreeable Scent.

This Ley of Sea-salt and Shell-lime has very little Virtue in dissolving the *Calculus*. It is true, that after lying some time in it, in a moderate Heat, the Surface of the Stone becomes white, and throws off a few rotten Scales; but it is three or four times longer in dissolving, than in Oyster Lime-water. And I have observed, that when no Potash was added to the Spirit of Sea-salt, although
the

the Ley were pretty free of the peculiar Taste of the Spirit; yet it seemed to have no Power almost at all of dissolving the Stone.

Hence we see, that, while in Soap-leys the dissolving Power of Quick-lime is greatly heightened by the Addition of an alkaline Salt, which of itself has little or no lithon-triptick Virtue; this same Quality of the Lime is greatly weakened, or entirely destroyed, by an acid Salt, which is naturally a Solvent of the *Calculus*.

The Quack Medicine sold at *London*, under the Name of the *Liquid Shell*, said to be calcined Shells, reduced to a liquid Form, and discovered by Baron *Schawenberg*, a *German* Nobleman, seems to be no other than such a Ley of Spirit of Sea-salt, Potash, and Shell-lime, as we have just now described; at least, so far as I have been able to observe, they agree in every Quality (q).
They

(q) Dr. *Linden*, in an Appendix to his late Book on Mineral Waters, has given us several Processes for making the liquid Shell; concerning the Virtues of which, he talks more in the Style of an Empirick, than of a rational Physician. His second Method of making it, is by pouring a Pound and a half of Water on calcined Oyster-shells and *Sch. Ammon. crud.* each a Pound.

They have precisely the same Colour and Taste; mixed with Spirit of Vinegar or Spirit of Vitriol, neither of them effervesce: Hence they are not alkaline. With a Ley of Potash, they make no Ebullition, but are turned into a white *Coagulum*. Upon adding Oil of Vitriol to them, a violent Ebullition ensues, with a strong Smell of Spirit of Sea-salt, and a white *Coagulum* falls to the Bottom. When mixed with a Solution of Mercury in *Aqua fortis*, they immediately precipitate the Mercury.

A Piece of *B*, four Grains, after twenty eight Hours warm, and as long cold Digestion, in a small Phial full of the *Liquid Shell*, had only half a Grain of its Substance dissolved.

Hence it appears, that this Medicine is neither acid nor alkaline, contains little of the Virtue of the calcined Shells, and has but a very inconsiderable Power of dissolving the Stone. How justly then it is said to dissolve the *Calculus* out of the Body in a few Hours, in a moderate Heat, or has been extolled as a grand *Alkali*, and a powerful Solvent of the Stone in the Bladder, is left to every one to judge.

S E C T.

S E C T. XI.

Of the particular Action of Lime-water, in dissolving the Stone.

ALTHO' it is of much greater Importance to Mankind to know that a certain Remedy is able to cure this or the other Disease, than to be informed of the precise Manner in which it produces this Effect; yet to investigate the Operation of Medicines in the Cure of Diseases, is not only a Subject worthy of a Physician, and highly entertaining to a philosophical Mind, but also of very considerable Use in Practice; for it is likely that a Medicine, whose real Nature and manner of acting upon the human Body are unknown, will be more judiciously and happily applied in the Cure of Diseases, than one, whose unknown Nature and specifick Operation, scarcely afford any Indication, in what particular Stages of a Disease, or Circumstances of the Patient, it may be used with the greatest Prospect of Success, and the smallest Chance of Mischief; when it may be most proper to administer it, and when to refrain from its Use. As therefore we have made it appear,

appear, that Lime-water not only dissolves the *Calculus* out of the Body, but sometimes even while in the Bladder; it will not, I hope, be looked upon as an useles Inquiry to endeavour to point out the particular Manner of its Operation.

The *Calculus* consists of Water, Earth, Air, Salt and Oil. Whatever *Menstruum* therefore, can separate any one of these Principles from the rest, will more or less dissolve or break the Stone.

The Water which enters the Composition of the *Calculus*, is not to be extracted but by the Force of Fire in Calcination, and the Earth is the most fixed and immutable of all its Principles; the Action of Lime-water therefore in dissolving the Stone, must be either upon its Air, Oil or Salt.

With respect to the first of these, as the *Calculus* when dissolved in a close Vessel, by Lime-water, generates no Air, it manifestly follows, that it does not act by separating this Element from the other constituent Parts of the Stone (q). But as Quick-lime readily unites

(q) Spirit of Nitre and *Aqua fortis*, indeed, generate a great deal of elastick Air, while they dissolve the *Calculus*, and are probably the most powerful Solvents of this Concretion,

unites with Oil, (*Seēt. 1. N^o 3.* above) it is probable that its subtile and highly attenuated Particles, which are invisibly suspended in the WATER, may seize upon and unite with the oily Parts of the Stone, and so contribute to destroy its solid Form: And the perfectly white Powder to which the *Calculus* is reduced by Lime-water, shews that this *Menstruum* acts, partly at least by extracting its Oil.

However, of all the Principles of the Stone, its Salt is that upon which Lime seems to act most powerfully. Every one knows that Quick-lime volatilises crude *Sal Ammoniac.* and Lime-water produces the same Effect, though in a less remarkable Degree.

And, as the animal Salts of the Urine and *Calculus* greatly resemble *Sal Ammoniac.* so we find that Lime acts upon them all in the same manner. Thus Urine mixed with Quick-lime, sends forth a penetrating saline urinous Vapour, which is stronger or weaker as the Urine is stale or fresh, or as it is more or less impregnated with Salts. Lime-water has a similar, but much weaker Effect. *Vid. Seēt. 1. N^o 7. and Seēt. 2. N^o 10.* above.

A

tion, because they act so remarkably upon its latent Air, which exceeds in Quantity all its other Principles taken together (a).

(a) *Hales's Staticks*, Vol. 2. p. 191.

A Piece of a *Calculus* which had been in my Custody seven or eight Years, being reduced to a Powder, and mixed with Quicklime, upon adding warm Water, and stirring the Mixture, sent forth a weak urinous Smell; but if this Stone had been recently extracted from the Bladder, it would have probably afforded a stronger and more penetrating Vapour.

May 12. 1750. I put an Ounce of Gravel-stones with a Pound and a half of Oyster-shell Lime-water, into a well-corked Bottle, and, having observed that the Stones seemed to dissolve no more after the first eight or ten Days, (though kept in a Heat of about 100 Degrees of *Fahrenheit's* Thermometer) on the 28th I poured off the Lime-water, and found about three Drams of the *Calculi* undissolved; the greatest Part being mouldered down into a white Chalk-like Powder.

The Lime-water had a yellowish Colour, and a very particular kind of urinous, stinking, sulphureous Smell, not easy to be described in Words. It had lost all Taste of the Lime, and, in place of it, had got a very disagreeable one of the same Nature with its Smell. This putrid Water, after being exposed to the Air three Days in an open Vessel, lost entirely its disagreeable

Disagreeable Taste and Smell, but retained its yellowish Colour. Whence we are led to conclude, that as the Colour of this Water proceeded from the grosser Oil of the *Calculus*, which is not volatile, so its Smell was owing partly to the more attenuated Oil, and chiefly to the Salt of the *Calculus* volatilised, and changed into a penetrating Vapour by the Action of the Lime-water.

It is observable, that as *Sal Ammon.* mixed with Lime-water, hinders it from throwing up any Scum, so the Lime-water in this Experiment neither afforded an earthy Crust while kept in the Bottle, nor afterwards when exposed to the open Air.

Nor does Lime act thus in volatilising the Salts of the Urine and *Calculus* alone; for Blood fresh drawn from a Vein, being mixed with equal Parts of Lime-water, immediately acquires a kind of burnt urinous Smell.

From what has been hitherto offered, it may seem to follow, that Lime-water dissolves the Stone, by volatilising its Salt, and uniting with its Oil: But then, as fixed alkaline Salts coin with Oil, and volatilise *Sal Ammon.* and the Salt of Urine as well as Quick-lime, it might be expected that a Solution of Potash, or Salt of Tartar in Water, should also dis-

solve the Stone; nay farther, as a strong *Lixivium* of any of these Salts acts much more powerfully in volatilising ammoniacal Salts, and unites much more readily with Oils than Lime-water, it ought by the preceeding Experiments and Reasoning, also to dissolve the Stone more quickly than this *Water*, which however is by no means the Case; for altho' a Ley of Potash renders the Stone whiter, more friable and somewhat rotten, yet it does not dissolve it (r).

Since therefore fixed alkaline Salts, which mix easily with Oils, and powerfully volatilise the ammoniacal Salt of the Urine, shew very little Power of dissolving the *Calculus*, the principal and peculiar Action of Lime-water, whereby it so remarkably dissolves this Concretion, must consist in its producing some Change upon the Principles of the Stone, different from what fixed alkaline Salts are observed to do. But the only thing in which the Action of Quick-lime, and of fixed alkaline Salts, upon *Sal Ammon.* and that of Urine, differs, is that while both seem equally to volatilise these Salts, the former also destroys their Power of effervescing with Acids, and so changes their Nature,

(r) Vid. *Hales's Exper. on Mrs. Stephens's Medicines*, and No. 62. above.

Nature, as to render them incapable of being reduced to a solid Form. The Virtue of Lime therefore, in dissolving the *Calculus*, seems chiefly to proceed from that Power which it possesses, not merely of rendering the Salts in this Concretion volatile, but of subtilising and dividing them in such a Manner as thoroughly to destroy their Nature and Texture as solid Salts.

Soap-leys, or a *Lixivium* of Potash and Quick-lime is a much more powerful Solvent of the Stone, than either Lime-water or a Solution of Potash in Water, because the alkaline Salt seems, by being joined with the Lime, to unite more readily with the Oil, and act more powerfully upon the Salt of the *Calculus*; at the same time, that the Lime may, from its Union with the alkaline Salt, acquire a greater Power of volatilising and destroying the Nature and Texture of the animal Salts: Further, Water impregnated with an alkaline Salt, attracts and retains the finer Parts of the Lime, in much greater Quantity than Water alone.

When a Fragment of a *Calculus* is immersed in Soap-leys, there appear to issue from almost every Point of its Surface *Striæ*, or oily Streams, which run through the Ley exhi-

biting much the same Appearance that *Alcohol* does when mixed with Water. These *Striæ* cannot be owing to elastick Air, emerging from the Surface of the Stone, since Soap-leys, in dissolving it generate no Air. Are they not more probably the oily, and perhaps saline, Parts of the *Calculus*, upon which this *Menstruum* acts most powerfully?

It is observable that while Lime-water dissolves the *Calculus*, it does not affect biliary Concretions, though much less firm and hard. The Reason of which is, that the former abound much more with Salt than the latter, and we have shewn above, that the lithonriptick Virtue of Lime-water is chiefly owing to its peculiar Action upon the Salts of the Stone. But a *Lixivium* of Salt of Tartar, although it has little Influence on the *Calculus*, dissolves the biliary Concretions (s); because the alkaline Salt unites readily with Oil, which is the Principle that abounds most in them.

Mr. *Morand* has remarked, that Mrs. *Stephens's* Medicines are not so successful in young as in old Patients (t); and I have observed the same Thing with regard to
Lime-

(s) *Hales's* Staticks, Vol. 2. pag. 192.

(t) *Memoires de l' acad. des sciences*, 1740, Edit. 8vo. p. 256. 268. and 269.

Lime-water and Soap. At first I was ready to ascribe this to Children's not taking these Medicines regularly, and in the proper Quantity; but, upon further Consideration, I am inclined to think there is something more in it, especially since my good Friend and Collegue Dr. *Alston*, who has of late been employed in making many curious Experiments on Lime and its Water, informed me, that he had observed *Calculi* extracted from Children to dissolve more slowly in Lime-water, than those which were taken from old People.

Children, on account of the weak State of their digestive Organs, and their Food being almost wholly of the acescent kind, are remarkably subject to Acidities in the *primæ viæ*. And if we may depend upon Mr. *Homburg's* Experiments, the Blood of young Animals affords a greater Quantity of Acid than the Blood of old ones (*u*); nor can this Acid be wholly deduced from the Sea-salt in their Blood, since in older Animals the Humors abound at least as much with this Salt, as in younger ones. It is not improbable, therefore, that in Children, the

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ammoniacal

(*u*) *Memoires de l'acad. des sciences, 1712.*

ammoniacal Salt of the *Calculus*, may contain a greater Proportion of Acid, than in old People. And as Clays, or argillaceous Earths, are said to be of no Use in Pottery, when deprived of their Acid, because they do not acquire a proper Firmness and Cohesion when burnt; so, perhaps, the Stone in old People may be of a less firm Cohesion, because their Fluids are more destitute of an Acid, than those of Children.

The Medicines, therefore, against the Stone, are probably less successful in young than in old Patients; not only because their Efficacy must be more weakened by the greater Proportion of acid in the *primæ viæ*, Blood and other Humors of the former, but also on account of the greater Firmness and Cohesion of the Principles of the Stone.

S E C T. XII.

Of the Cure of the Stone.

HAVING given an Instance of the Success of Lime-water in dissolving the Stone, and illustrated its Virtue this Way by a Variety of Experiments; in the Course of which we
 have

have been so lucky as to discover the remarkable Virtue of Oyster and Cockle Shell Lime above Stone-lime; it remains that a Method of Cure be laid down, founded upon the above History and Experiments.

I. First, then, I would advise the Patient to swallow every Day, in any Form that is least disagreeable, an Ounce of the internal Part of *Alicant* Soap (*x*), and drink three *English* Pints or more of Oyster or Cockle Shell Lime-water. If he takes the Soap in Pills, or shaved down as Mr. *Millar* did, he may divide it into three Doses; the largest to be taken fasting in the Morning early; the second, at Eleven before Noon; and the third, at Five or six after Noon; drinking above each Dose a large Draught of the Lime-water; the Remainder of which he may take after Dinner or Supper, instead of other Liquor. The disagreeable Taste of the Lime-water may be blunted, by adding a very little sweet Milk to it; and is quite destroyed, by washing one's Mouth immediately after drinking it with a little Vinegar and Water; which, however, must be carefully spit out again

(*x*) The external Part, which is discoloured by the Air, is deprived in a good Measure of its Virtue, See No. 73. above.

again (y). But, if the Patient finds Difficulty in taking the Soap in this Form, or if it does not sit easy on his Stomach, let him dissolve (z) an Ounce of it in an *English* Pint and a half of warm Lime-water, made with Shells that have been long exposed to the Weather, and take this at three different Times, drinking the rest of the Lime-water by itself. If it should happen, that Shell Lime-water cannot be had, then let him take the same Quantity of Stone Lime-water, with at least an Ounce and a half of Soap; since its dissolving Power is so much increased by it (a).

It is observable, that a Solution of Soap in Lime-water has not so disagreeable a Taste, as a Solution or Decoction of it in common Water.

The Soap is not only proper to be taken along with the Shell Lime-water, as it is endued with a considerable Power of dissolving the Stone, but likewise as it will destroy all acid Humors in the Stomach and Guts, contribute greatly to keep the Belly easy, and prevent

(y) One Dram and a half, or two Drams, of Juniper-berries, infused in every Chopin Bottle of it, will mend its Taste much.

(z) A Solution is preferable to a Decoction. See No. 56. above.

(a) See No. 66. above.

prevent any Costiveness that might otherwise be occasioned by the Lime-water.

At first the Patient should begin with a smaller Quantity of the Lime-water and Soap than what is mentioned above; perhaps an *English* Pint of the former and three Drams of the latter, taken daily, may be enough. This Quantity, however, he may increase by degrees; and ought to persevere in the Use of these Medicines, (especially if he finds any Abatement of his Complaints, or Symptoms of the Stone dissolving) for several Months, nay, if the Stone be very large, Years.

Further, it may be proper for the Patient (if he is severely pained) not only to begin with the Soap and Lime-water in small Quantities, but also to use the second or third Lime-water, instead of the first. However, after he has been for some time accustomed to these Medicines, he may not only take the first Water, but, if he finds he can easily bear it, heighten its dissolving Power still more, by pouring it a second time on fresh calcined Shells (*b*). An *English* Quart of this strong Lime-water, with an Ounce, or an Ounce and a half of Soap dissolved in it, and taken daily, would, I dare say, answer as well in calculous.

(*b*) Vid. Sect. iii. No. 21. above.

calculous Cases, and be as little disagreeable, as any Method yet proposed.

During a Course of Lime-water and Soap for the Stone, the Patient should abstain from all acid and fermented Liquors, as Vinegar, Wine, Ale, Beer, Cyder, &c. For his Drink he may have Water and Milk, or a Ptisan made with Roots of Althea, Parsley, and Liquorice: But, if he has been accustomed to more generous Liquors, and cannot confine himself thus far, he may be allowed a little Mountain Malaga, or some weak Punch, made without any Acid; but, as the Virtue of Soap is much weakened when dissolved in Punch (*c*) and entirely destroyed by Spirits (*d*); and as Quick-lime has its Nature considerably changed by them (*e*), they ought not to be drunk by themselves, nor even in Punch to any great Quantity. It will also be proper to be sparing in the Use of salt Meats (*f*), and Honey (*g*), and to refrain from all Fruits that have any Acidity or Sharpness (*h*); while, on
the

(*c*) See No. 69. above

(*d*) Hales's Experiments, p. 2.

(*e*) See No. 1. and 2. above.

(*f*) No. 50.

(*g*) No. 34. and 71.

(*h*) No. 36. and 38.

the other hand, Milk and Sugar (*i*) and animal Food, with the Vegetables mentioned No. 39.—45. may be safely used.

As the Cure depends upon the Urine being strongly impregnated with the Virtues of the Lime-water, the Patient ought to drink no more of any other Liquors than is necessary to quench his Thirst, and should retain his Urine as long as he can without Uneasiness, that it may have the greater Time to act upon the Surface of the Stone.

If, from catching cold, or too violent Motion or Exercise, the Patient's Pains shall happen to be greatly increased, it may be proper to lessen, or even to abstain for a few Days from his Medicines, and to have recourse to Opiates, emollient Clysters, Fomentations and warm Baths. If the Soap and Lime-water shall occasion a greater Heat and Thirst than usual, thirty or forty Drops of dulcified Spir. of Nitre may be taken in a Draught of Lime-water twice or thrice a Day (*k*).

If the Lime-water should chance to occasion Costiveness, it will be proper now and then to take a Pill, of equal Parts of Aloes and Soap, or any other of the Purgatives mentioned No. 51.—55.

If,

(*i*) No 33. and 35.

(*k*) Vid, Sect. x. No. 75. above,

If, instead of the Soap, a Quarter of an Ounce of a Ley made with purified Potash and calcined Oister-shells, diluted with five Ounces of Lime-water, an Ounce of sweet Milk, and half an Ounce of Syrup of Sugar, were swallowed twice or thrice a Day; it would, probably, be less burdensome to the Stomach, and certainly would contribute more to the speedy Dissolution of the Stone as it is possessed of a much stronger lithontri-ptic Virtue than the Soap. And this Ley is preferable to common Soap-leys, as we have already observed; not only upon account of its being less nauseous, but also as it is a more powerful Solvent of the *Calculus* (1).

But if we should meet with any Patients who have an invincible Aversion to Soap in any Shape, or to whom, upon account of Ulcerations in the urinary Passages, it would be improper either to prescribe Soap or this alkaline Ley; in such Cases the above Experiments give us Reason to think, that Oister or Cockle Shell Lime-water alone drunk in large Quantities, will have fully greater Effect in dissolving the *Calculus*, than Stone Lime-water,

(1) See above, No [64.]

water, even when assisted by Soap (*m*): So that, in place of all Mrs. *Stephens's* Medicines, which to many delicate People can be of little Use, we may substitute this Lime-water with equal, nay probably greater Success.

To put this beyond any reasonable Doubt, I need only relate the following Experiment.

Dr. *Hartley's* Mass of Soap, Lime, and Salt of Tartar (*n*), which contains every thing valuable in Mrs. *Stephens's* Medicines, is by him ordered to be taken from three to four Ounces a Day; and I have often prescribed Lime-water from three to four *English* Pints daily: To know, therefore, from which of the two Medicines the greatest Benefit is to be expected in the Cure of the Stone, I dissolved that Gentleman's Mass in sixteen times its Weight of boiling Water, and immersed in it a Piece of *B*, of thirteen Grains; and at the same time infused another Fragment of *B*, of the same Weight, in Oister Lime-water, made with six Pounds of Water, to one Pound

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of

(*m*) Compare the Experiments of the dissolving Power of Oister and Cockle Shell Lime-water, No. 14.—20. with Experiments of the Effects of a Solution of Soap in Stone Lime-water, No. 66. See also the Table in Sect. xiv. of this Essay.

(*n*) See Page 2. and 3. above,

of fresh calcined Shells. After thirty five Hours warm and twenty three cold Digestion, the Fragment in the Lime-water had six Grains and a half of its Substance rotten and dissolved, while that in the Solution of Dr. *Hartley's* Mass had only lost three Grains.

Dr. *Hartley* in his *Latin* Epistle to Dr. *Mead*, published last Summer, has proposed a Variety of Methods, in which Powder of Lime, Soap, Soap-leys, or fixed alkaline Salt may be taken for the Cure of the Stone: But as the following Composition, which was communicated to me, at his Desire, by Dr. *Hales*, differs in some Things from any of the *Formula's* in his Epistle, I shall, here, give it to the Publick.

“ Take *Alicant* Soap shaved, eight Parts,
 “ Oyster-shell Lime one Part, pour upon
 “ them a little Water, and beat them into
 “ a soft uniform Mass: Then dissolve this
 “ Mass into an Emulsion, by adding more
 “ Water, so as to make six Quarts of Emul-
 “ sion from every Pound Avoirdupois of
 “ Soap. Let this Emulsion stand exposed
 “ to the Air for a Month in a wide-mouth-
 “ ed Vessel, being stirred frequently and laved
 “ in and out of the Vessels, as in cooling
 “ Liquors. By this means it will become
 “ mild

“ mild to the Taste, Stomach, and urinary
“ Passages. The Dose is half a Pint three
“ times a Day. It may be called the al-
“ caline Emulsion for the Cure of the
“ Stone.”

Altho' it is probable that this Emulsion, like the Solution of Dr. *Hartley's* Mass above mentioned, would dissolve the *Calculus* out of the Body, more slowly than strong Oyster-shell Lime-water, yet it may perhaps produce as great or greater Effects in the Body, because it contains a certain Quantity of Lime not fully slaked, which must therefore communicate its Virtues to all the Humours it meets with in its Passage through the Stomach and Guts. However, as the safest, and least offensive, Way of conveying the Virtues of Lime into the Blood, is by drinking its Water; and as this Water, by being poured a second or third time upon fresh calcined Shells, may have its Strength and dissolving Power greatly increased (*o*), I would still prefer it to Powder of Lime, in whatever Form. But, in Cases where the Lime-water and Soap fail in giving the Patient Relief, the above Emulsion may be safely tried.

Such as have no Stone in the Bladder, but
L 2 are

(*o*) Vid. Sect iii. No. 21. above.

are subject to frequent Fits of Gravel in the Kidneys, might very probably prevent these, by drinking every Morning, two or three Hours before Breakfast, an *English* Pint of Oister or Cockle Shell Lime-water; which though it might be too small a Quantity to have a sensible Effect in dissolving the Stone, yet would probably prevent any new Concretions.

Patients who have small Stones in their Kidneys, often pass (especially before a nephritick Paroxysm) dark-coloured Urine, very much resembling Moss-water or Coffee, and frequently feel some kind of dull Pain or Uneasiness in that Part of their Back where the Kidneys lie. I have known some Patients who, after discharging this kind of Urine for several Weeks, have in two or three Days voided 70 or 80 small Stones, like Pin-heads; after which they continued for a considerable Time free of all gravelish Complaints.

The dark Colour of the Urine in these Cases is owing to Blood mixed with it, which oozes slowly, and in small Quantity, from the Vessels of the Kidneys eroded by the rough Surfaces of the Stones lodged in them. This Blood does not run into Clots, because it is mixed with the Urine very gradually, and only

ly in a small Proportion; and it loses its red Colour, by being retained a considerable Time in the Body, before it is evacuated, In like manner, Blood ouzing slowly from the small Vessels of the Stomach, and lying there for some time, is vomited up of a dark Coffee Colour, and often mistaken for black Bile; whereas, when it flows in a greater Stream, and from larger Vessels, it is thrown up with its natural Colour, either in Clots, or in a fluid Form. The best Remedies for this dark coloured Urine are mucilaginous Drinks, such as *Arabic Emulsion*, a Decoction of *Althea Root*, or an Infusion of *Lintseed*, which defend, in some degree, the Vessels of the Kidneys against the Roughness of the small Stones lodged in them; and *Lime-water*, which, while it softens and renders smooth the Surfaces of these Stones, has, at the same time, a Tendency to heal the eroded Parts. Proper Doses of *Opium* are also useful, as they not only facilitate the Expulsion of the small Stones lodged in the Kidneys, but lessen their Power of doing Mischief while they remain there.

II. In order to render the Cure of the Stone in the Bladder still more speedy, I shall offer a Proposal which, how far it may succeed, is

left to the Judgment and Experience of others.

It is this, that such Persons as have a Stone in the Bladder, should, at the same time they are taking the Medicines above directed, have four or five, or more Ounces of tepid Shell Lime-water injected into their Bladder every Day, to be retained as long as they can without Pain; for which Purpose they should evacuate their Urine immediately before the Injection. Were it not for the Trouble of introducing the *Catheter*, such Injection might be made twice or thrice a Day; and if a flexible *Catheter* were always kept in the Bladder (*p*), it might be done as often as one pleased, and so the Dissolution of the largest Stones might be quickly procured. It may perhaps be proper to let the Patient drink Lime-water some Days before he uses it by way of Injection, in order to mitigate his Pains, and take off that Tenderness of the internal Coat of the Bladder, which generally attends this Disease; after which he will, with less Difficulty, be able to retain it when injected, so as it may have Time to act on the Surface of the Stone.

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(*p*) Heist. chirug. p. 883. and 938.

The Injection of warm Water into the Bladder has often been practised in order to the high Operation for the Stone; and if then it was sometimes attended with bad Consequence, this seems to have been owing to the great Quantity injected, whereby the muscular Fibres of the Bladder, which resist such Distension, were too much and too suddenly stretched: But in the present Case (unless the Stone be very large) so small a Quantity will be sufficient, that if it be cautiously gone about, I do not see any Hurt it can do. And as from the Quantity to be injected, no bad Consequences are to be feared (q), so neither is it probable, that from the
Quality

(q) In *Le Dran's Observat.* 80. we find a Decoction of Marshmallows was injected into the Bladder, Morning and Evening, for a considerable Time, without the smallest Inconveniency, and with remarkable good Success in that particular Case; which was, as he calls it, a *Vessie racornie*: To save the Trouble of introducing the *Catheter* twice, he let it remain in the Bladder from the Morning till after the Evening Injection was over. And in *Dr. Hales's Staticks*, Vol. 2. p. 212. we are told, that in four Hours Time he caused, by means of a double *Catheter* there described, 900 cubick Inches, or three *English Gallons* of warm Water, to flow in and out of a Bitch's Bladder in a continual Stream, without the least Harm or Inconveniency to the Animal that he could perceive.

Quality of the Liquor any would arise : For Lime-water, we see, may be taken into the Stomach in great Quantities without any Harm, and when applied to the Eye, one of the tenderest Parts of the human Body, it occasions no considerable Uneasiness: It is made use of to wash Sores with very good Success. And, as sometimes along with the Stone there are small Ulcers or Excoriations in the Bladder, the Lime-water, either injected or taken by the Mouth, will dispose them to heal up, instead of having any of the bad Effects which are to be feared from Mrs. *Stephens's* Medicines, which render the Urine highly alkaline; and of which I had, some Years since, occasion to see an Instance in a Patient, who, having several Symptoms of a Stone in the Bladder, had frequently taken a good deal of Soap, by which his Pains, especially in making Urine, were always so greatly increased, that he was obliged to lay aside the Use of it : But, upon inquiring more narrowly into his Case, I found he had, along with the Stone, an Ulcer in his Bladder, and passed considerable Quantities of purulent Matter. Agreeably to this Mr. *Morand* has observed, that in such Cases where, along with the Stone, there were any Ulcerations in the Bladder, Mrs.

Stephens's

Stephens's Medicines always occasioned great Pain and Uneasiness (*r*); while, on the other hand, *Dr. Langrish* found, that, when, by injecting too great a Quantity of Soap-leys, he had made Dogs void Blood with their Urine, Lime-water would immediately be retained in the Bladder without any Uneasiness, and quickly heal up the small Vessels, which the Acrimony of the Soap-leys had eroded (*s*).

That the Injection of Lime-water into the Bladder may be rendered more safe, and attended with less Uneasiness, two Scruples or a Dram of *Starch* may be dissolved in six or eight Ounces of Oyster Lime-water, and just brought to boil over the Fire, stirring it all the while: For having put a Piece of *B*, seven Grains, in such a Mixture as this, in three Hours Time there was a white rotten Crust formed all round it, which fell off upon shaking the Glass, and, in twenty four Hours time, above a Grain of it was dissolved. The Heat used in this Experiment did not exceed 100 Degrees in *Fahrenheit's* Thermometer.

The fourth Part of the Yolk of an Egg being mixed with six Ounces of Lime-water,
does

(*r*) *Memoires de l'acad. des sciences*, an. 1740.

(*s*) *Physical Experiments*, p. 12.

does not weaken its Virtues any more than the Starch, and may occasionally be used in place of it.

I tried also *Gum. Arab.* and *Sem. Lini*; but they both destroy the Virtue of Lime-water, more than the Starch or Egg.

I was very much pleased to find, that the Proposal I had made in the first Edition of this *Essay*, of injecting Lime-water, into the Bladder, with a View to the Dissolution of the Stone, had engaged the ingenious *Dr. Langrish* to pursue this Matter a good deal further. This Gentleman, in his *Physical Experiments upon Brutes*, published 1746, has shewn, that the Bladders of Dogs can not only bear Stone and Oister Shell Lime-water injected twice a Day for a Month, without any Pain or ill Effect following, but Lime-water mixed with Soap-leys, in the Proportion of fifteen, twenty, or twenty five Drops of the latter, to each Ounce of the former, provided a little Starch be added to blunt the Acrimony of the Soap-leys.

In the Year 1745, *Mr. John Campbell*, late Surgeon in this Place, at my Desire, injected near two Ounces of Oister-shell Lime-water, in which a little Starch was dissolved, into the Bladder of a Boy about ten Years of Age,
who

who had been taken into the *Royal Infirmary* to be cut for the Stone. We directed him to empty his Bladder before the Injection was made, and he retained it without any Pain or Uneasiness for near three Hours.

Mr. *Campbell* after this injected, into the Bladder of a Man, Lime-water unmixed with any thing to soften it; which, however, gave no Pain nor Uneasiness, although retained a considerable Time. So that from these Trials upon the human Body, and Dr. *Langrish's* Experiments upon Dogs, it appears, that the only thing wanting in order to the Dissolution of the Stone by Injections, is an easy Way of conveying these into the Bladder; for the introducing a common *Catheter* twice or thrice a Day, would necessarily give a good deal of Uneasiness, and soon fret the Parts; and it is not easy to contrive a flexible *Catheter* that could be always retained in the Bladder, without considerable Inconveniency. I have for some time entertained an Opinion, that, if a Syringe was made with a small Pipe joined to it, which might be introduced three or four Inches into the *Urethra*, and the *Penis* grasped pretty firmly, so as that it should closely embrace the Pipe of the Syringe, a Liquor might be pushed with such Force into the *Urethra*, as

to overcome the Resistance of the *Sphincter Vesicae*, and make its Way into the Bladder, without doing any Harm, or giving much Pain (*t*). And in this Sentiment I have been confirmed by a Gentleman, some Years since my Patient, who informed me, that he had frequently, without any *Catheter*, forced the *Sphincter*, and thus injected Lime-water into his Bladder, for the Cure of an Ulcer there. Nor do I apprehend, that an Injection forced into the Bladder in this Way, would be in any Danger of penetrating into the excretory Ducts of the *Prostatae*, or *Vesiculae seminales*, before it overcame the natural Contraction of the *Sphincter*.

In order, however, to be fully satisfied as to this Matter, I recommended to Mr. WILLIAM BUTTER, Student of Physick to try if he could not inject a Liquor, into the

(*t*) Or perhaps it might do better if there was an Ivory Pipe made, five or six Inches long, and of the Size of a common *Catheter*, with a Sheeps-bladder tied upon its greater End, as is usually done in Clyster-pipes: For if the Injection was put into this Bag, and the Pipe introduced into the *Urethra*, it could be much more equably forced into the Bladder, than by a Syringe, which is apt to jerk, and is far from being so much at one's Command. See Langrish's *Experiments*, p. 51.

the way just now proposed, into the Bladders of some of the Patients in the *Royal Infirmary*. He got an Ivory Pipe made of about $4\frac{1}{2}$ Inches in length, whose Diameter was $\frac{1}{8}$, and its Bore $\frac{1}{10}$ of an Inch: Upon the great End of this Pipe, which was formed like a common Clyster Pipe, he tied an Ox's Bladder; and, having put four or five Ounces of warm Milk and Water into it, introduced the Pipe near four Inches into the *Urethra* of *Thomas M'Curfy* aged nineteen; then directing him to grasp his *Penis* strongly with his Hand, he pushed forward the Injection with a good deal of Force; but, thro' a Neglect of some of the Directions to be mentioned below, little or none of the Liquor penetrated into the Bladder. However, after a few unsuccessful Trials, he pushed first four Ounces of Milk and Water, and afterwards four Ounces of Milk, into the Bladder of this Patient, without giving him any Pain or Uneasiness.

But as this Experiment did not succeed quite so well when I was present, I ordered a Pipe to be made of the same Diameter with the one above mentioned, but of 7 Inches in Length, thinking that, by this means, the injected Liquor might be made to act with more Force upon the *Sphincter* of the Bladder. As a Piece

of Ivory could not be procured 7 Inches long, the Pipe was made of Tin. Upon the great End of it a Bladder was fastened, into which having put five Ounces of Stone Lime-water, with half that Quantity of Milk, and firmly tied the Bag, Mr. *Butter* introduced the Pipe into the *Urethra* of the before-mentioned Patient, ('till, with my Finger, I felt the Point of it within less than an Inch and a half of the *Anus*) and endeavoured to push forward the Injection by strongly pressing the Bag, which, being too weak, burst before almost any thing had got into the Bladder. But, having afterward procured a stronger Bag, he injected, between the Hours of Two and Eight in the Afternoon of this Day, four different times, into the Bladder of *Thomas M'Curfy*, five Ounces of tepid Oister-shell Lime-water, unmixed with any thing. The Injection was generally performed in a Minute, sometimes a good deal sooner. The same Afternoon (viz. *June 30. 1752*) he injected five Ounces of Lime-water into the Bladder of *Thomas Saunderson*, another Patient in the *Infirmery*, aged 30, in the Space of forty Seconds. These Patients neither complained of Pain when the Pipe was introduced, the Injection pushed, nor when they voided the Lime-water, only *M'Curfy* said,

said, he perceived a little more *Stimulus* than when he used to make Urine, but not so much as to give him any Uneasiness worth mentioning. They had no Inclination to empty their Bladder immediately after receiving the Injection, and were able to retain it without any Difficulty. Altho' the Lime-water was perfectly limpid, yet when they voided it, after having been retained some Time in the Bladder, it had a turbid Appearance, and looked as if a few Drops of Milk had been added to it. That this Change of Colour in the Lime-water was owing to the Urine mixed with it, during its Stay in the Bladder, is evident from Sect. II. N^o 11. where it is shewn, that Lime-water, when mixed with Urine, becomes whitish and turbid.

July 6. Mr. *Butter*, when I was present, injected with the short Pipe, near five Ounces of Milk and Water, in little more than half a Minute, into the Bladders of the same two Patients, notwithstanding one of them had, at the Time the Injection was made, a little of a Strangury from a Blister on his Head. Whence it appears, that the Length of the Pipe is not a Circumstance so material as, at first, I was apt to imagine.

In order to make the Injection of Lime-water into the Bladder succeed better, it may be of Use to attend to the following Directions, which were observed by Mr. *Butter* in most of the above Experiments.

1. The Patient ought to empty his Bladder immediately before the Operation.

2. He should lie in Bed upon his Back, with his Legs drawn up to his Body, and his Thighs afunder.

3. He should be forbid to restrain Respiration, but desired to breathe in his usual Way. He must likewise be put on his Guard, to give no Resistance to the Injection, when he feels it entering into his Bladder, and to restrain any Attempt to make Urine, altho' he should, at that Time, have a small Inclination to it.

4. The Liquor to be injected should be blood-warm, or nearly so.

5. The Bladder fixed to the Pipe must be strong, and very firmly tied, otherwise it will be apt to burst, or to allow the Injection to escape by the Ligature.

6. The Pipe should be dipt in Oil before it is introduced into the *Urethra*.

7. After the Pipe is introduced, the Patient must compress his *Penis* very firmly with his
Hand,

Hand, else the Liquor, instead of making its Way into the Bladder, will return by the *Urethra* towards the Point of the Yard.

8. The Bag containing the Liquor to be injected must be pressed by one or both Hands of the Operator, with a very considerable Force, in order to dilate the *Sphincter* or Neck of the Bladder.

9. At first the Lime-water may be softened, by mixing it with a little Milk or Starch, and only four or five Ounces of it injected; but afterwards the Quantity may be increased to six Ounces, and double Lime-water may be used (*u*).

10. As, from the Principles of Hydrostaticks, it is evident, that the Force required to dilate the *Sphincter* of the Bladder must be, *cæteris paribus*, proportional to the Surface of the Liquor contained in the Bag, no more should be put into it, than is intended to be thrown into the Bladder. The not attending to this Circumstance, was not only one Reason of the Bag's bursting, but also of the Injection's not passing so easily into the Bladder, in some of the first Experiments, which were made with the Pipe of $4\frac{1}{2}$ Inches in Length.

M 3

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(*u*) Vid. Sect. 3. No. 21. above.

It may be worth while to observe, that, as one can, at pleasure, some how relax, in a small Degree at least, the *Sphincter Vesicæ*, a Patient would probably, after a few Trials, learn to push the Liquor precisely at the Time of the Relaxation, whence he would make the Injection with more Success upon himself, than the ablest Surgeon could do upon another. But as more Force may be sometimes required than he can apply with one Hand, Mr. *Butter* is of opinion, that, if the Liquor to be injected were put into a Pair of small Bellows contrived for the Purpose, and the Pipe screwed to their Nose, the Patient could with little or no Difficulty bring the Sides of these Bellows together, so as to push the Fluid contained in them into the Bladder with great Force.

In the other Sex, whose *Urethra* is streight and much shorter than in Men, the Pipe above described may be introduced into the Bladder itself without giving any Pain, and so the Injection be pushed into it with the greatest Ease.

If five Ounces of Oyster-shell Lime-water were thus injected into the Bladder of either Sex, at seven or eight in the Morning, at Noon, and at Six in the Evening, and retained two or three Hours each time, there can be no doubt

doubt but that the Stone must as certainly be dissolved in this way, as if it were immersed in a Phial full of Lime-water, though indeed not so soon. And in Women, who may be easily taught to make the Injection themselves, the Stone must, in time, be so certainly dissolved, that, for the future, it will only be necessary for them to have recourse to the Operation of Lithotomy in very rare Cases, where the Stone is of such Hardness, as to resist the Force of the Oyster-shell Lime-water.

Further, as the severe stimulating Pains, which generally accompany the Stone in the Bladder, are not so much owing to its Bulk, as to the Roughness of its Surface, the Oyster-shell Lime-water injected, in the Manner above described, twice or thrice a Day, would not fail, in a very short time, to give certain Relief from these Pains, by dissolving the sharp Points of the Stone, and converting its Surface into a soft chalky Substance.

However, it is to be observed, that while Lime-water is thus injected into the Bladder with a View to the Dissolution of the Stone, it ought also to be drunk to the Quantity of an *English* Quart at least, and an Ounce of *Alicant* Soap taken along with it, every Day:

As

As this will not only destroy that Quality in the Urine, whereby it generates and increases the Stone; but will communicate some degree of a dissolving Power to it, and consequently hinder it from weakening the Force of the Lime-water injected into the Bladder, so much as it would otherwise do.

S E C T. XIII.

Comparative Value of the several Medicines.

THAT the Method of Cure just now proposed may appear with greater Advantage, I shall state in few Words the comparative Value of the several Medicines that are thought to bid fairest for dissolving the Stone. Of these only Lime-water and Soap can be safely taken into the human Body. Spirit of *Nitre*, Spirit of Sea-salt, Soap-leys, or the fiery *Lixivium* of No. 64. and Quick-lime, being all deadly Poisons, are only capable of being used when diluted in a large Quantity of some watery Vehicle. And even then they do not promise so much as Lime-water: For as the Virtue of Spirit of *Nitre* seems to consist in its extraordinary corrosive Acidity, which must
be

be destroyed before it gets into the Blood, and still more so before it arrives at the Bladder; I think nothing can reasonably be expected from it, or any Medicines of this kind. In answer to this, it has been alledged, that although vegetable Acids are entirely changed by the digestive Powers of the human Body; yet this is not the Case with respect to mineral Acids: To which purpose the learned *Boerhaave* is quoted; where, in his Chymistry, he observes, that such Acids as are fit to dissolve Gold, Silver, &c. are generally too strong for the concoctive Powers of Animals, and hence become Poisons. But this Authority is as strong as any thing can be against those who use it: For, if the mineral Acids above mentioned are entirely changed by the Powers of the human Body, it is confessed they can have no Effect in dissolving the Stone; and, if they are not destroyed, they become Poisons, and consequently cannot safely be exhibited with a View to the Dissolution of the *Calculus*.

Spirit of Sea-salt is liable to the same Objections as Spirit of *Nitre*; at the same time that it is not near so powerful a Solvent of the Stone (*x*).

With

(*x*) See No. 76. above.

With regard to Soap-leys, or the fiery *Lixivium* of N^o 64. it may be observed, that as they owe a great deal of their destructive Quality to an Ingredient that has scarce any Effect in dissolving the Stone (y), they do not seem so well calculated for this End as Lime-water; which, at the same time that it is strongly saturated with that Principle to which the Soap-leys owe their Virtue, is free of the alkaline Salt, which renders them in a great measure so noxious. But to set the Virtue which these two Medicines have of dissolving the Stone still in a clearer Light, it may not be improper to compare the Effects which Soap-leys had on Dr. *Jurin*, with what we have seen of Lime-water in the Case of Mr. *Miller*.

Dr. *Jurin*'s Stone in his Bladder seems to have been but of two or three Months standing when he began his Medicines; whereas Mr. *Miller*'s was of above fifteen Months. Dr. *Jurin* took Soap-leys in very large Doses for near five Months before he passed any Stones; and, after taking them near seven Months, does not seem to have been perfectly cured (z): Mr. *Miller*, in seven Weeks after

(y) See No. 62. above.

(z) See his Case, p. 145.

after he began to drink Lime-water, voided one Stone, as in three Months he did another, and has ever since been perfectly well. Mr. *Miller* had no Pain upon using the Lime-water (*a*), but in few Days began to perceive a gradual Abatement of all his Complaints; while Dr. *Jurin* had his Pains considerably increased by the Soap-leys at first; nor does he seem to have had any sensible Ease, till after using them above four Months.

By what has been just now said, I would not be thought to reject the Use of Soap-leys altogether in the Cure of the Stone; on the contrary, I imagine, that small Doses of this Liquor, taken along with Lime-water (*b*), may contribute greatly to the Dissolution of the *Calculus*; only I would not chuse to give it in such large Quantities as to occasion great Pain or Heat of Urine to the Patient; or in any Case where there are Ulcerations or Sores in the Bladder. And, instead of common Soap-leys, I would recommend the *Lixivium*
of

(*a*) Nor is Mr. *Miller* a single Instance of this: For of all the Patients, for whom I have ordered Lime-water in the Stone, I do not remember that one had his Pains increased by it.

(*b*) See Sect. xi. No. 1. above.

of N^o [64.] made with purified Potash and Shell-lime, for the Reasons there offered.

Quick-lime, as we have already observed, has been a long time looked upon by the Chymists, as containing in it a powerful Remedy against the *Calculus*. The Powder of calcined Egg-shells, which makes a principal Part of Mrs. *Stephens's* Medicines, is commended by *Barbette* as of incomparable Use in all Suppressions of Urine from the Stone or Gravel (c): And the Ashes of burnt Snails, another Ingredient in her Medicines, are mentioned near seventeen hundred Years since, by *Pliny*, as a good Remedy against the Stone (d). But, from the above Experiments, it seems reasonable to think, that the Virtues, whether of Stone or Shell Lime, may be more safely conveyed into the Blood by means of Lime-water than any way else; for

(c) *In omnimoda urine a calculo suppressione, testæ ovarum calcinate ad scrup. ii. vel drach. i. assumptæ; omnia reliqua medicamenta præcedunt. Barbette Praxis, lib. 4. cap. 8.*

(d) *Easdem (sciz. Cochleas) exemptas testis tritasq; tres in vini cyatho bibi, sequente die duas, tertio die unam, ut stillicidia urine emendent. TESTARUM VERO INANIMUM CINEREM AD CALCULOS PELLENDOS. Plin. Histor. natural. Lib. xxx. cap. viii.*

for Lime, fresh from the Fire, is too fiery and corrosive to be taken into the Stomach; and, after it is slaked by two or three Months keeping, as Mrs. *Stephens* directed, it gains in Mildness only what it loses in Virtue (*e*); though, even after all, it is a Medicine which seems to be neither innocent nor agreeable.

Soap is not only inferior to Lime-water, as its lithontriptick Virtue is less, but as it abounds with an alkaline Salt, which, when the Soap is taken in large Quantities, occasions great Pains in the urinary Passages, and is of bad Consequence if there are any Ulcerations in these Parts. Nay, the stimulating Quality of Soap is so remarkable, that although Lime-water, with a small Proportion of Soap-leys, softened with a little Starch, gave no Uneasiness when injected into the Bladders of Dogs; yet a small Quantity of Soap dissolved in the same Lime-water, never failed soon after being injected, to cause great Irritation; nor was the Starch of any Avail to prevent this (*f*).

But further, how strongly soever several of the above mentioned Medicines may be endowed with a Virtue of dissolving the Stone;

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yet

(*e*) See No. 20. above.

(*f*) Langrish's physical Experiments, p. 30.

yet Lime-water seems to have this incontestable Advantage, that it may be injected most safely into the Bladder; and by being applied immediately, and unchanged to the very Surface of the *Calculus*, it may be well expected to hasten its Dissolution very considerably.

It has been alledged by some, that Lime-water alleviates the Patient's Pains, by covering the Surface of the Stone with the calcareous Matter which it contains, and consequently rather increases than lessens its Bulk: And that it cruffs the Stomach all over with a Coat of Lime; and therefore must be a pernicious Medicine when taken in large Quantities, and used long.

In answer to these Objections, which, as they are founded in Ignorance, reflect little Honour on the Authors of them, it is sufficient to observe, that a large Quantity of Lime-water contains only a very small Portion of earthy Matter (*g*), and that it does not deposite one Grain of this Matter as long as it is kept close from the external Air. Since therefore the Urine, while in the Bladder, has as little Communication with the external Air, as if it were in a Bottle hermetically sealed, the Lime-water, which
makes

(*g*) See pag. 66. above.

makes a Part of it, can let fall no Powder to cover the Surface of the Stone. Add to this, that Lime-water mixed with *Sal Ammoniac.* or Urine, neither throws up a Scum, nor lets fall a calcarious Sediment, even when exposed to the Air (*b*). Indeed as Lime-water changes the calculous Matter in the Urine into a light white Sediment; if this should be supposed to cover the Surface of the Stone, it would, in some measure, defend the Bladder against its sharp Points.

It may be thought that Lime-water perhaps lets fall Part of its calcarious Matter in the Stomach, which is not always shut, but has a Communication with the external Air as often as we swallow: This, however, seems to be prevented by the little Access which the Air has to the Stomach, the short Stay which the Lime-water makes in it, and the Mixture of the different Things it meets with there. Further, as Lime-water becomes effete, as soon as it loses its earthy Matter (*i*), if it were deprived of this in the Stomach, it would become ineffectual in the Cure of the Stone. But Experience, which is the most satisfactory Proof of the Innocence of any Medicine, shews

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us,

(*b*) See pag. 21. and 109. above.

(*i*) See page 61. and 62. above.

us, that Lime-water may be used daily in large Quantities, and persisted in for Years, without injuring the Health, impairing the Appetite, or weakening the Digestion; nay, it often mends all these. This was the Case with the Honourable HORATIO WALPOLE, Esq; who, after he had used Lime-water and Soap above three Years, wrote me, that they were so far from hurting him in any respect, that they had given him a better Appetite, and improved his State of Health.

Altho' there are few urinary Stones so hard as to resist Oyster-shell Lime-water out of the Body, yet, as the Virtues of this Medicine, as well as Soap, are greatly weakened, by their being mixed with the whole Mass of Blood, before they arrive at the Bladder, it is no Wonder if they make but small Impression on the harder Stones, and only dissolve such as are of the softer kind. However, even in Cases where they are not able to accomplish an entire Dissolution, they generally give surprising Ease to the Patient, and, at least, prevent the farther Growth of the Stone. They produce the last Effect, by destroying the petrifying Quality of the Urine (*k*); and the first, by wearing off the sharp Points and rougher Parts
of

(*k*) Vid. Sect. ii. No. 11. above.

of the Surface of the Stone, which used to prick and irritate the tender Membrane of the Bladder: At the same time, it is not improbable, that the small Part of the Stone, which is dissolved by the Medicines, may, partly, remain on its Surface, in the Form of a white chalky Powder, as happens to Gravel Stones immersed in Lime-water out of the Body.

But, as it would betray no small Weakness to believe, that Lime-water and Soap always dissolve the Stone when they relieve the Patient, so it bespeaks a Mind greatly under the Influence of Prejudice to deny that these Medicines ever dissolve this Concretion; since there have been many Instances of Patients, who, by the Use of them, have passed calculous Fragments at different Times, for Months, nay Years together. However, as it may be alledged by some, that these Fragments were not Part of a larger Stone, and so no Proof of the dissolving Power of the Soap and Lime-water; I shall here mention one Case, where the contrary was evident beyond all Manner of Doubt. The Reverend Mr. J. L. a Clergyman of this Church, who had been much afflicted with the Stone in his Bladder, not only found himself greatly relieved of his former Complaints, by swallowing daily, for

a few Months, an Ounce of *Alicant* Soap, and drinking near three *English* Pints of Oyster-shell Lime-water, but passed a vast Number of calculous Fragments of different Sizes; the largest was $\frac{3}{5}$ of an Inch in Length, and near $\frac{1}{4}$ of an Inch in Breadth. Their Surface was partly covered with a white chalky Crust. All of them were thin and appeared evidently to be *Strata*, Layers or Coats thrown off a large Stone; especially the larger Pieces, which were remarkably convex on one side, and concave on the other. An Instance not unlike this we have recorded by the celebrated Dr. *Mead*, in the following Words: “*Medicus* “*quidam Londinensis, mihi amicissimus, hac* “*ipsa medendi via mercatorem graviter la-* “*borantem eripuit; plurima enim frustula,* “*nunc crustularum, nunc exiguuorum nucle-* “*orum instar, simul cum urina foras ejicie-* “*bantur (1).”*

Upon the whole, we have found in Lime-water, particularly in that which is made with Oyster or Cockle Shells, a *Menstruum* for the *Calculus*, so innocent and mild, that it may be taken into the Stomach without any Harm, and injected into the Bladder without the least Danger of corroding it. Such a *Menstruum* as
this

(1) *Monita et præcepta medica, cap. x. p 478.*

this the learned *Boerhaave* did not despair of being one Day discovered, as he had found the Spirit of Rye-bread possessed of a surprizing Power to dissolve certain Stones, though it did not injure any Parts of the human Body (*m*).

I don't know whether it will be thought worth while just to observe, that Lime-water appears, from the above Experiments, to be possessed of all the Qualities which *Van Helmont* required in a Medicine that should safely dissolve the Stone: As,

1. *Aptum sit in urinam mutari, ut scilicet locum affectum tangat.* That Lime-water alters the Nature of the Urine, and communicates its Virtues to it, appears from *Exper.* under Sect. ii.

2. *Habeat in se potestatem solvendi repagula calculi.* See *Exper.* under Sect ii. and iii.

3. *Possideat istud in proprietate specifica.*

4. *Sit subtile, ut quaquaversus eat, suumque eminus objectum demoliri queat.* See Sect. ix.

N^o 57. 59. and 61.

5. *Amicum sit naturæ, ne scilicet cuncta pervertat.* See Sect. iii. N^o 19. and Sect. ix. N^o 61.

SECT.

(*m*) *Boerhaave* *Chemia*, vol. 1, de *Menstruis*.

S E C T. XIV.

The dissolving Powers of the Menstrua.

IF, in the foregoing Experiments, the Weights of the several Pieces of the same *Calculi*, and the Times they were immersed in the different *Menstruums*, had been all equal, the Strengths of the *Menstruums* would at first sight have appeared; but since the Case is otherwise, and I did not advert to this Inconveniency arising from it, till it was too late; in order to make it up as much as possible, I shall here subjoin a Table of the Proportions which the dissolving Powers of the *Menstruums* for the *Calculus* in the above Experiments bear to one another; but, previous to it, I shall briefly mention the Grounds upon which it is built.

I suppose that the Times in which different Pieces of the same homogeneous *Calculus* will dissolve in any *Menstruum*, to be as their Surfaces. And, supposing their Surfaces to be as the square Roots of their Weights or Quantities of Matter, (which would be exactly true were they all either perfect Cubes or Spheres,

or their Figures exactly similar), the Times required for two different Pieces of the same *Calculus* to dissolve in any *Menstruum* will be, *cæteris paribus*, as the square Roots of their Weights.

If the Weights of two Pieces of the same homogeneous *Calculus* are equal, and the Times which they are immersed in different *Menstruums* are also equal, the Powers of the *Menstruums* will be as the Quantities dissolved.

If the Weights and Quantities dissolved are equal, the Powers of the *Menstruums* will be inversely as the Times during which the *Calculi* were immersed.

If the Quantities dissolved and Times of Immersion of two Pieces of the same *Calculus* are equal, the Forces of the *Menstruums* will be inversely as the square Roots of their Weights.

If the Times, Weights and Quantities dissolved are unequal, the Powers of the *Menstruums* will be as the Quantities dissolved directly, and as the Times and square Roots of the Weights inversely. Thus, supposing *m*. *M.* to be the *Menstruums*, *q*. *Q.* the Quantities dissolved, *t*. *T.* the Times the *Calculi* were immersed, and *w*. *W.* their Weights, then

$$m : M :: q \times T \times \sqrt[2]{W} : Q \times t \times \sqrt[2]{w}.$$

If two *Calculi* of different Textures be put in the same *Menstruum*, the Hardness of the one will be to that of the other, as the Times and square Roots of the Weights directly, and as the Quantities dissolved inversely. If $m=M$, then $b:H :: t \times \sqrt[2]{w} \times Q : T \times \sqrt[2]{W} \times q$.

Hence, by comparing Experiment 15, and 16. the Hardness of the *Calculus A* is to that of *B*, as 380 to 406 ; and this it was necessary to take notice of, as, in several Articles of the following Table, an Allowance was made for this Difference in the Hardness of these two Stones.

T A B L E.

<i>Menstruums.</i>	<i>Dissolving Powers.</i>
Stone Lime-water, <i>Exper.</i> 11.	— 202
Oister-shell Lime-water, <i>Exper.</i> 16.	583
Cockle-shell Lime-water, <i>Exper.</i> 17.	583
Lime-water made with Oister-shells that had lain 35 Days after calcining in the open Air, <i>Exper.</i> 20.	— 215
Oister-shell Lime-water and Honey, <i>Exper.</i> 34.	— — 146
	Oister-

<i>Menstruums.</i>	<i>Dissolving Powers.</i>
Oister-shell Lime-water and Sugar, <i>Exper.</i> 35.	340
Stone Lime-water in cold Digestion, <i>Exper.</i> 13.	091
Oister Lime-water in cold Digestion, <i>Exper.</i> 18.	229
A Solution of Soap in common Water, <i>Exper.</i> 70.	143
A Solution of the external Part of Soap, <i>Exper.</i> 73.	079
A Solution of Soap in Stone Lime-water, <i>Exper.</i> 66. first Trial	406
Second Trial	494
<i>Exper.</i> [66.]	328
A Solution of Soap with Sugar, <i>Exper.</i> 71.	134
A Solution of Soap with Honey, <i>Exper.</i> 71.	067
Lime-water made by pouring a weak Solution of Soap on calcined Oister-shells, <i>Exper.</i> [67.]	681
Lime-water made with a stronger Solution of Soap, <i>Exper.</i> [67.]	1003
Potash and Stone Lime-water boiled, <i>Exper.</i> 63.	0178

<i>Menstruums.</i>	<i>Dissolving Powers.</i>
A Ley of Potash and Stone-lime, <i>Ex-</i> <i>per.</i> 64. — — —	3449
Another Ley of the same kind, <i>Ex-</i> <i>per.</i> 64. — — —	1768
Common Soap-leys, <i>Exper.</i> [64.] —	3671
A Ley of Oister-shell Lime and Potash, <i>Exper.</i> [64.] — — —	5874
A stronger Ley of Potash and Oister-shell Lime <i>Exper.</i> [64.] — —	7343
A Mass of Soap, Salt of Tartar, and Quick-lime dissolved in sixteen times its Weight of Water. <i>Pag.</i> 253.	308
Strong Lime-water made with fresh cal- cined Oister-shells one <i>lib.</i> and boiling Water six <i>lib.</i> <i>pag.</i> 253. — —	666
<i>Aqua fortis simplex</i> in cold Digestion, <i>Ex-</i> <i>per.</i> 64. — — —	858
And, supposing its dissolving Power to be increased in a digesting Warmth, in the same Proportion as that of Oister- shell Lime-water, then the dissolving Power of <i>Aqua fortis simplex</i> in warm Digestion will be — —	2184

P O S T.

P O S T S C R I P T.

Edinburgh, Nov. 9. 1742.

AS I conceive the following History, incompleat as it is, may serve considerably to recommend the Use of Lime-water in the Stone, I have sent it to be published, (if you think it deserves a Place in your Collection) as an *Appendix* to a former Paper upon this Subject.

James Litster, of *Macky's-Mill*, in the County of *Fife*, aged fifty seven, about nine Years ago, was much hurt by a severe Fall upon a Millstone; and, after that, began to be troubled with Gravel in the Kidneys and *Ureters*. At this Time he had a great Pain in one of his Kidneys, and Stoppage in his Belly, like an *Iliac Passion*. After a Clyster, he had Passage, and was easier, and the Stone or Stones passed into his Bladder: But he did not observe that he voided any with his Urine, till a long Time after: And, ever since this, he has had all the Symptoms of a Stone in the Bladder. He has great Pain in making Urine, is not able to use Exercise, and, upon Motion, feels the Stone pricking him in his

O Bladder.

Bladder. Riding at a Trot gives him remarkable Uneasiness; and, after it, or much Walking, his Urine is generally tinged with Blood.

He has been subject for several Years to have his Symptoms at certain Periods exasperated. During the Fit, he is in great Distress; and his Urine, which he has an Inclination to make every two or three Minutes, comes away in Drops, with severe stimulating Pains. The Fits generally last three, sometimes four Weeks, and return after an Interval of fourteen or twenty Days.

He took Mrs. *Stephens's* Medicines for two Months, without any Benefit; but found his Pain increased by them, his Stomach put out of order, and Appetite greatly destroyed.

He has also used Soap for some time, to the Quantity of three fourths of an Ounce a Day; but without any sensible Benefit.

I advised him, along with the Soap, to drink Lime-water made with calcined Cockle-shells, beginning with two *English* Pints; and, if it agreed with him, to increase the Quantity to three Pints or more every Day.

Upon the 1st of *June* 1742, a few Days before he began to use the Lime-water, he was attacked with a severe Fit of Pain, and
Difficulty

Difficulty of Urine; which lasted twenty Days; in which Time he passed a good deal of tough Slime. But, in eight or ten Days after this was over, he found himself easier than he had been for a Year before, and made his Urine more freely, and with less Pain.

July 2. Having used the Lime-water scarce four Weeks, he rode fourteen Miles to a Market. During the Riding, he felt some Pain in his Bladder. Notwithstanding which, next Day, he was quite easy; whereas, formerly, if he had made any Journey on Horseback, he was sure the Day following to be in the utmost Distress, and to continue so for seven or eight Days.

When he stoops down, or makes any sudden Motion, he still feels the Stone pushing him in the Bladder; but not near so sharp as usual. His Urine, since he used the Lime-water, deposites a great deal of whitish Sediment; and he thinks it has given him a better Appetite than he has had for several Years past.

From the 2d of *July*, he drank above three Pints of Lime-water every Day; and was very easy till the 20th of that Month; when he had a Fit as usual; but it lasted only eleven Days: And then, he had only Pain in ma-

king his Urine; which, however, was less severe than what he had formerly been used to have. His Belly being generally costive during the Fit, I ordered him an Infusion of *Senna*; from which he had considerable Relief.

He continued very well all the Month of *August*; and walked, upon the 20th, six Miles in a few Hours, without any Pain or Trouble: Whereas, for some Years past, he could not walk, even one Mile without much Pain.

Upon the 1st of *September*, he found his Urine much obstructed, and had a Fit which lasted nine Days: But, though his Provocations to Urine were frequent, and the Difficulty in making it considerable; yet, after voiding a few Drops, he was easy, and had no stimulating Pains. From this Time, to the End of *October* last, he was as well as if he had had no Stone, was able to go about his Business, from which he had been long laid aside, and was fit for any Work that did not require great Strength. He can ride now as well, either at a Trot or Gallop, as ever, and never finds any thing pricking him in his Bladder, not even when he has the Fit. From the Beginning of *July* he made no use of Soap, and found no other Inconveniency, than that
he

he thought the Lime-water bound his Belly a little more for the want of it. He is so sensible of the Benefit he has had by drinking Lime-water, that he is resolved to persist in it, in hopes of a compleat Cure (b).

I have had occasion to order Oyster-shell Lime-water for many other Patients afflicted with the Stone ; but have not yet met with an Instance, except one, where it was drank to

O 3

the

(b) From *October 1742*, *James Litster* continued drinking the Lime-water near two Years, to the Quantity of three *English* Pints a Day ; during which Time, he passed great plenty of sandy Stuff, was remarkably easy, and went about his ordinary Business, without any Pain or Interruption. After *September 1744*, he gave over the constant Use of it : But, when after catching Cold, or great Fatigue, he had Difficulty of making his Urine, with some Pain, and passed a good deal of Slime, with some Sand ; upon having recourse to the Lime-water in smaller Quantities, he was soon relieved. Since the Year *1744*, he has, upon Motion, felt nothing weighty like a Stone in his Bladder (as he used formerly to do) although he has often walked ten Miles a Day, made pretty long Journeys on Horseback, and frequently rode at a Gallop. So that it seems probable, that the Stone, if yet undissolved, is at least considerably diminished in its Bulk, and softened in its Surface. It may be worth while to observe, that this Patient, notwithstanding his drinking Cockle-shell Lime-water for above two Years, to the Quantity of three *English* Pints a Day, had neither his Appetite nor Digestion any way impaired, nor his Health injured by it.

the Quantity of three *English* Pints a Day, and any tolerable *Regimen* observed, without the Patient's finding himself in a few Weeks sensibly easier. When the Stone is small, this will happen most remarkably as was the Case with Mr. *Miller*; but, if it is very large, even after its Surface is softened, and the rough Points worn off it by the Lime-water, it is not to be imagined, but that by its Bulk it must sometimes give Uneasiness, especially in making Urine: But the Patient has this to comfort him, that while he continues his Medicine, the Stone is daily growing less. And there is one sure Mark by which any one taking Lime-water, Soap, or Soap-leys, for dissolving the Stone, may know if his Urine is so far changed, as not to be further capable, at least of furnishing any new Matter for increasing its Bulk, *viz.* if, by the Use of these Medicines, the Sediment of his Urine, from a brownish Colour, becomes white.

I shall only make one Observation upon this History, which the most rigid Infidels, with regard to the Dissolution of the Stone, must acquiesce in; and that is, Supposing Lime-water could not dissolve the Stone; yet, since it is capable of giving such Ease and Quiet to
those

those who labour under it, whether would it not be more advisable for such, especially if advanced in Years, to resolve upon drinking a Bottle of this every Day, during their whole Life, than submit to one of the most cruel, and, at the same time, not the least dangerous Operations in Surgery?

A P P E N -

A P P E N D I X.

T H E

C A S E

O F T H E

Hon^{ble} HORATIO WALPOLE Esq;

[Written by Himself.]

A P P E N D I X

T H A T

C A S E

O F T H E

HON^{OR} HORATIO WALPOLE ESQ

(Printed by ...)

The HISTORY of Mr. WALPOLE's Case.

Containing an Account — of his being first troubled with Stones passing from his Kidney; with the Relief he found, for several Years, by drinking Whey;—of his being afterwards afflicted with the Stone in his Bladder, and cured of all its painful Symptoms, by taking Soap and Lime-water, according to the Directions of Dr. Whytt in the fifth Volume of the Scotch Medical Effays. In a Letter to the Honourable Mr. Baron EDLIN of his MAJESTY's Court of Exchequer in Scotland.

April 21. 1750.

ABOUT eighteen Years ago, when his MAJESTY resided at *Hampton Court*, I was taken ill with what was thought to be a Fit of the Cholick only, being subject to that Disorder when I was very young, and the Physicians treated me accordingly: When, some Days after, I was got perfectly well, in making water one Morning, I voided a Stone in the Pot about the Bigness of a Barley-corn, which, without doubt, had occasioned, while it lay in the Ureter, the cholical Pain I had felt.

felt. From that Time, I was frequently troubled with severe Fits of the same Pain, which lasted until, by Turpentine-clysters, and other lubricating Medicines, I had brought away a Stone: Being advised at last to drink a Pint of Whey, made with Cream of Tartar every Morning; and, having followed that Method from the Beginning of *May* to *November*, at the End of two Years, (during which Time, my Pains frequently returned and ended in the same Manner), I found myself perfectly cured: For, having persisted in drinking Whey yearly, I continued free from those Pains, voiding only at Times some red Gravel till 1747. In the Spring of that Year, whilst I was at a Friend's House in Town, to dine there, having Need to make Urine, I made, instead of it, what appeared to be almost clear Blood; and so, from time to time, for almost all that Year, I was often called upon to make water, by very short Intervals, which was more or less discoloured, seldom very clear, and frequently attended with great Pain and some Gravel. That whole Year, until the next Spring, I took Variety of Things of a lubricating and cooling Nature, which it is unnecessary to detail, without any good Effect. The next
Winter

Winter, in Town, I found I grew daily worse, and, altho' I did not always make bloody or Coffee-water, yet my Provocations to Urine, (which, after a hasty Gush of a Spoonful of Water, suddenly stopt with excessive Pain) were more frequent, and were attended with a *Tenesmus* and Irritation at the End of my Yard. Mr. *Ranby* the Surgeon, and Mr. *Graham* the Apothecary, having often visited me, and having got constant Accounts of my Disorder and the Symptoms that accompanied it, both declared, there must be a Stone in my Bladder. I was willing to be probed; but, as I had no Thoughts of being cut, Mr. *Ranby* declined undertaking that troublesome Office, being persuaded, without the Trial, I had a Stone in my Bladder. Lord BARRINGTON, hearing of my Complaint, was so good as to send me the Volume of *Scotch Medical Essays* containing Dr. *Whytt's* Account of the good Effects which taking Soap and Lime-water had had in Cases similar to mine, with ingenious Reflexions and Directions relating to that cruel Disease, and the Remedy for it. I read them with great Satisfaction, and would have immediately fallen into that Method; but my Relations, touched with the fatal Effect which Dr. *Jurin's Lixi-*

vium had had upon the late Lord ORFORD, would not suffer me to follow my own Inclinations.

While I had a severe Fit upon me, I was visited by the Earl of MORTON, who, upon hearing what was my Disorder, gave me an Account of the powerful Benefits and entire Cure which Mr. Somers (a) had found in voiding

(a) Late one of the Commissioners of his Majesty's Customs in *Scotland*.

The Earl of MORTON having, at this Time, wrote to Mr. Somers to know more particularly the Method of Cure which he used, received from him the following Letter, which his Lordship was pleased to give me, with Allowance to publish it with Mr. WALPOLE's Case.

My LORD,

“ In obedience to your Lordship's Commands, which
 “ reached me yesterday, I have the Honour to send you
 “ an Account of the Regimen which recovered me from
 “ a most deplorable Illness that had, a long time,
 “ baffled our ablest Physicians.

“ I took four Drams of *Alicant* Soap, four times a
 “ Day, early in the Morning, at eleven before Noon, at
 “ five Afternoon, and at going to bed. Upon a Distaste
 “ I have to Pills, I dissolved each Dose in about Half a
 “ Pint

ing the Stone that had tormented him for many Years, by adding Lime-water to the Soap, which he had taken for some time without Success.

This Example, by the Encouragement of Mr. *Graham* my Apothecary, fixed my Resolution to follow that Method; and accordingly, before I left the Town, I often perused Dr. *Whytt's* Essay relating to the Stone.

In *March* 1747, I began at first with taking every Day, Half an Ounce of *Alicant* Soap, made into Pills, with a Syrup of Marshmallows, and drank upon it about a Pint of Lime-water made of Oyster-shells, mixing a Spoonful of Milk with it, and drinking a

P 2

Spoonful

“ Pint of Oyster-shell Lime-water: To make the Draught
 “ more palatable, I added a little Milk. The Lime-water,
 “ thus mixed, was the only Liquid I drank, during
 “ my Indisposition; and, as I think its Power alone
 “ sufficient to prevent any new Concretion, I intended to
 “ continue in that Practice. By this Method, my dismal
 “ Complaints, in a few Weeks, vanished; and, in
 “ about two Months, I happily voided a small Stone, quite
 “ smooth, and to be sure much diminished by this Dissolvent;
 “ having frequently before discharged Gravel of the same
 “ Colour. I heartily wish it may have the same Effect upon
 “ your Lordship's Friend.—I am, &c.

EDINBURGH, *November* 10.

1747.

Spoonful after it, to take away the Nauseousness of the Taste.

Upon the Road, as I went into the Country, in *May* 1748, I had a most severe Fit at *Newport*, making bloody Water; with frequent Interruptions, and short Intervals, attended with violent Pains, which continued upon me to such a Degree, that I could not endure the Horses to go more than a Foot Pace for above 70 Miles, till I got home.

After my Arrival there, I was tolerably well for some Days, but the least Motion in a Coach, or even in Walking, brought the Disorder upon me. I was always (which is remarkable) entirely easy when I lay a Bed; but was obliged, when I got up, to take to my Couch, and could not venture to move from thence but on some necessary Occasion. In the mean time, I continued to take the Soap and Lime-water, which, by degrees, I increased so far as to take, at different Times, an Ounce of Soap, and three Pints of Lime-water a Day; observing a very regular Diet. After some Months I found myself extremely easy in my ordinary Motions; but I never ventured to walk far, nor go at all in a Wheel-carriage, keeping myself as quiet as I could; until I should be obliged to go to Parliament.

Just

Just before I left the Country, Mr. *Ranby* made me a Visit; and, altho' I had felt no Pain or Symptom of my Disease for some time, he advised me not to hazard going to Town, by any Means, unless in a Litter; however, having caused a Voiture to be made, I undertook the Journey in it, the 20th *December* 1748, which was regulated by the Horses going no faster than a gentle Walk, and but twenty Miles a Day.

The cold Weather, and the Tedioufness of creeping so slow, made the Coachman sometimes fall into a Trot; which I perceived, but finding no Inconvenience, did not check his Pace. The set Stages were observed; but the last two Days, and particularly the last Day, the Coachman drove from *Harlow* to *White-chappel*, as full a Trot as the Horses could go at any Time, and I felt not the least Disorder. I took a Chair at *White-chappel*, and all that Winter, used nothing else, and continued extremely well: But, about two Months after my Arrival in Town, I found some small Uneasiness in making water, and, in two or three Days, I voided, with my Urine, something of a flat Shape, about the Bigness of a Silver Penny, covered with a soft white Mucus, which, when it was dry, was plainly of

a stony Substance, and, after that, have never since been troubled with the least Symptom of that cruel Disease. And I found myself so well in the Country, last Year 1749, that, contrary to the Advice of all my Friends, I undertook, in my Coach, a Journey to *Chatsworth* in *Derbyshire*, at least 160 Miles from my own House in the Country, to pay a Visit to the Duke of DEVONSHIRE, the Horses going as round a Trot as they could conveniently according to the Road; and the last 10, or rather 15 Miles, from *Hardwick* to *Chatsworth*, a most rugged and rocky Way, we neither spared ourselves nor our Horses; and altho' the great Shocks upon the Stones broke the Springs of my Coach, yet they gave me not the least Uneasiness; and I have ever since continued, with respect to my former Disorder, as well as I ever was in my Life: But I now and then voided some red Gravel after I had sat a great while in the House of Commons.

As I never perceived that I voided, during my Illness, any Fleaks of a Stone, besides the above-mentioned, and was never searched by any Instrument; I can no otherwise pronounce it to be a Stone, unless by the Symptoms I felt, and the Judgment of the Surgeon

geon and Apothecary that attended me, from these Symptoms.

But it is very remarkable, as I have said before, that I never felt these Symptoms while I lay a-bed, nor to so great a Degree when on my Couch as upon my Legs; which looks as if the Posture made great Alteration; and that, methinks, could not have been the Case, if I had been troubled with a scorbutick corrosive Humour only. I must leave it to the learned in Physick, to make what Conclusions they think fit from this true State of my Case. I think I remember in some of Dr. *Whytt's* Observations, that although the Soap and Lime-water were not able to dissolve or bring away the Stone, yet they might cure its painful Symptoms, and hinder it from vulnerating any Part of the Bladder, by blunting its sharp Points, rendering its Surface smoother, and even covering it, in some Measure, with a kind of Mucilage. This may possibly be my Case if I have still a Stone there; and therefore I continue to take the third Part of the Soap and Lime-water daily, which I used when I took the full Quantity.

H. WALPOLE.

The

The SEQUEL of Mr. WAL-
POLE's Case.

*Containing an Account of the State of his Health,
with respect to the Stone in his Bladder, from
November 1750, to the End of April 1752.*

Cockpit April 28th 1752.

AFTER having found myself, for two
Years together, perfectly well, and free
from all Symptoms of my former Disorder, I
took no more than one third of the Soap, and
Lime-water that I had formerly used.

In *November 1750*, I came out of the Coun-
try, in my Coach, in the usual travelling Pace,
without the least Inconvenience; but having
ventured, after I came to Town, to go now
and then in a Coach upon the Stones, I began,
at Times, to feel the Symptoms of my for-
mer Disorder, which upon any Motion, be-
sides that of going in a Chair, even by walk-
ing to any Degree, increased upon me; and
driving only in my Chariot, through the
Parks, to *Kensington*, without going upon the
Stones, I found myself much troubled with
making,

making, frequently and involuntarily, Water, sometimes bloody, tho' not with much Pain.

However, taking the Precaution of going by Water, as far as the *Old Swan*, and being carried from thence in a Chair as far as *White-chappel*, I ventured in a Chariot, fitted up with the best *French Springs*, to go into the Country with Mrs. WALPOLE, last *June* about Mid-summer; but before I had got half-way to *Epping*, though the Horses went but a slow Pace, I felt as great Uneasiness, attended with the same severe Symptoms, as I had ever done; which frequently returned and continued upon me, during the whole Journey, for four Days together; with little or no Abatement, but while I was in Bed; where, as formerly, after I had laid sometime, I was perfectly easy the whole Night.

As soon as I got out of my Chariot, upon my Arrival at my House in the Country, I had indeed a cruel Fit, but after I had rested one Night, and kept myself as quiet as possible, for a few Days; I found myself perfectly well again; and as I never went in a Coach, and did not walk much during my whole Stay in the Country last Year, for about five
Months

Months together, I never felt the least Symptom of Uneasiness.

Some few Days before I left the Country, I took a Turn or two round my Park, in my Chariot, free from Pain, which encouraged me to undertake a Journey to Town again, last *November*, in my Chariot, by short Stages and gentle driving; and it was performed, in five Days, to *White-chappel (a)*, without being sensible of the least Inconvenience any Part of the Way: Neither have I felt any since my Arrival in Town, and I still continue well, taking daily, as I have constantly done since *June 1751* when I went last into the Country, the full Quantity of Soap and Lime-water, that I formerly took; *viz.* an Ounce of the former, and near three Pints of the latter.

H. WALPOLE.

(a) From Mr. *Walpole's* House, in *Norfolk*, to *London*, is about a hundred Miles.

F I N I S.



