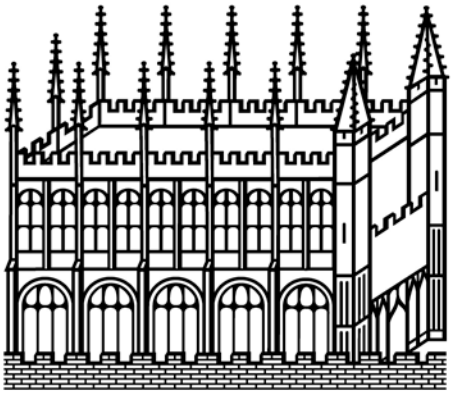

A N

ESSAY

For Introducing a

PORTABLE LABORATORY:

By Means whereof all the

CHEMICAL OPERATIONS

Are Commodiouſly Perform'd,

FOR THE

Purpoſes of PHILOSOPHY, MEDICINE, METALLURGY, and a FAMILY.

With SCULPTURES.

By *PETER SHAW*, M. D.

AND

FRANCIS HAUKSBEE.

LONDON:

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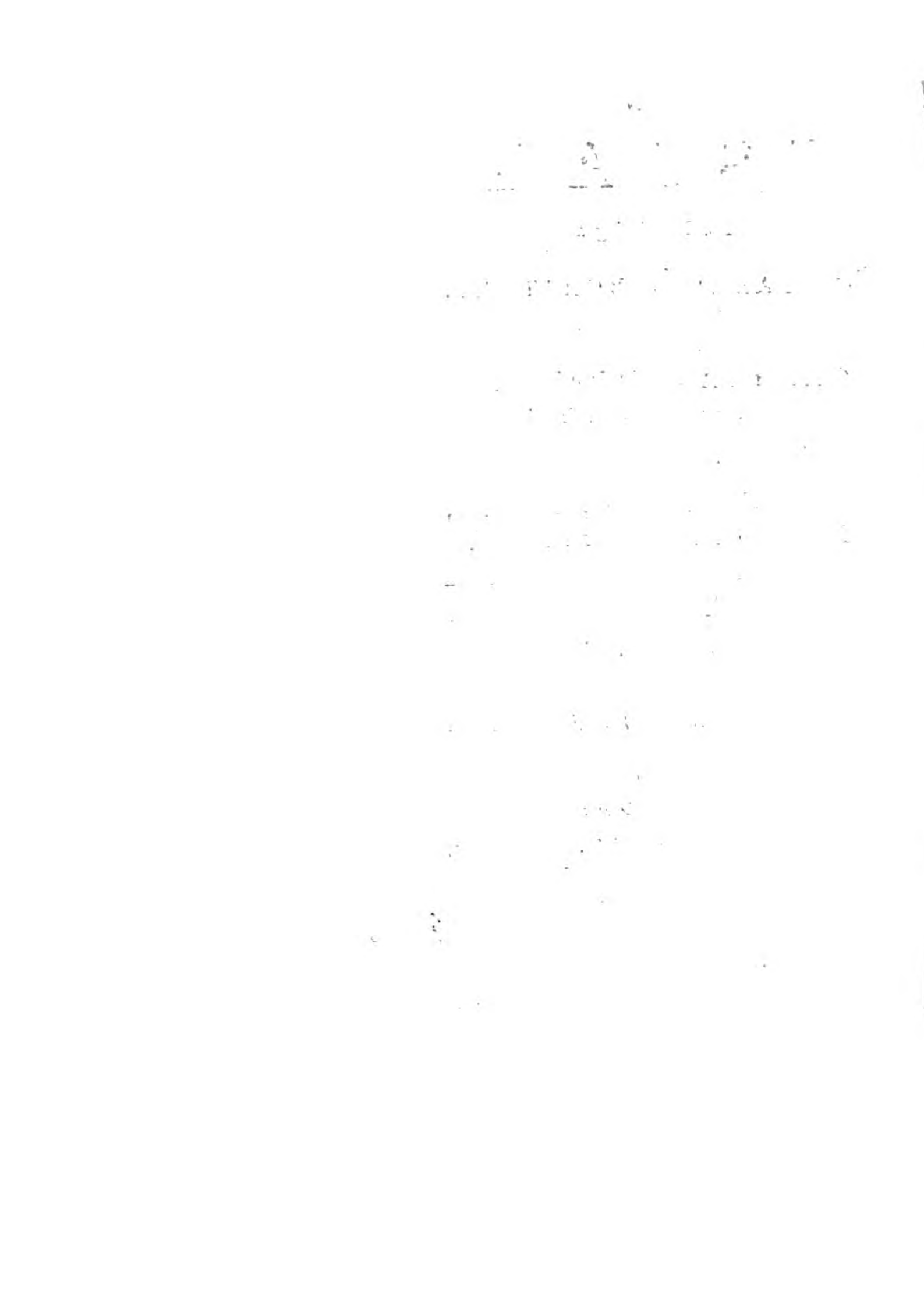
M. DCC. XXXI.



TO

Sir *Hans Sloane* Bar^t.
Preſident;

The COUNCIL; and the reſt of the
FELLOWS of the ROYAL SOCIETY,
London:

THIS

ESSAY,

AND THE

PORTABLE LABORATORY
it deſcribes,

As a Means of Promoting

NATURAL KNOWLEDGE,

Are humbly ſubmitted by

PETER SHAW,

and

FRANCIS HAUKSBEE.

AN EXPLANATION OF THE PLATES.

PLATE I.

GIVES *an* external VIEW OF THE FURNACE, *when all its Parts are out of uſe.*

A. *Repreſents the* COVER, *with its upright* FUNNEL.

B. B. *The two* RINGS.

C. *The* BODY.

D. *The* cloſe FOOT.

a a a. *The Places of the three* GRATES.

E. E. *The* Top ELBOW-FUNNEL.

F. F. *The* Lateral FUNNEL.

See the Eſſay *Pag.* 14, *&c. and Plate* II, & V.

PLATE II.

GIVES *an* internal VIEW *of the* Separate Parts of the FURNACE.

A. *Repreſents the* COVER.

B. *One of the* RINGS.
C. *The* BODY.
D. *The* close FOOT.
E. *The* open FOOT.
F. *One of the* GRATES.
a. *and* b. *are only expletive, and repreſent the firſt a* black Crucible, *the other a* Cementing-Pot.

For the reſpective Uſes of the Parts, ſee Eſſay *Pag.* 14, 15. *and* Plate III. *&c.*

PLATE III.

REpreſents *a* SMELTING-FURNACE *at work, compos'd only of the* Body *and* cloſe Foot, C, *and* D, *without a* GRATE.

See the Eſſay *Pag.* 16. *and* Plate I, & II.

PLATE IV.

EXhibits *a* TESTING-FURNACE, *preparing for the* Operation; *and conſiſting of the* COVER A. *with its upright* FUNNEL; *the* RING B; *the top* GRATE, *placed at* a; *the* BODY, C, *and the* open FOOT, E.
b. *A* Teſt.
c. *A* Muffle.

See Eſſay *Pag.* 17. *and Plate* I, *and* II.

PLATE V.

EXhibits *a* DIGESTING-FURNACE, *compoſed of the Ring* B, *with its* Pan P, *and ſtanding upon*

upon the Body *and open* Foot, C, *and* E, *and containing Water, or Sand, &c.*

See Eſſay *Pag.* 16.

L. *Repreſents a* Lamp (*to ſtand on the* Grate a, *in the* Ring B,) *with its Ball, of Oil or Spirit, fitted on to the Elbow coming out at the Door-way of the Ring*, B.

See Eſſay *Pag.* 15.

D D D D *are Digeſting Glaſſes, and* P P *the* Pan *for making a* Balneum Mariæ, *or Sand-Heat, &c.*

PLATE VI.

Repreſents a Hot-Still, *at work; where the* common Cover *is changed for a* Pewter Still-Head, A, *and the* Veſica, *or* Copper Veſſel, V, *goes into the* hollow Ring, B; *the* middle Grate *being placed at* a, *in the* Body C, *ſtanding upon the* open Foot E.

X *denotes the* Refrigeratory, *containing its* Pewter Worm.

See Eſſay *Pag.* 16. *and Plate* I, *and* II.

PLATE VII.

Repreſents a Furnace *for* Distilling *by the* Capella vacua, *where the* Ring, B. B. *furniſh'd with three* Iron Pots *and their* Covers, *ſo as to confine the* Retorts *without any* Sand *between, ſtands upon the* Body C, *with its* lateral Funnel F, *the* middle Grate *at* a, *and the open* Foot, E.

H. *an* Iron Pot *repreſented out of the* Ring.
I. *the* Iron Cover *of the* Pot.
e e e e *are Looſe Stopples, or Vents, to regulate the Fire.*
b b b *Retorts.*
c c c *Receivers.*
See Eſſay *Pag.* 17. *and Plate* I, *and* II.

PLATE VIII.

Exhibits a Furnace for Sublimation *and* Diſtillation *by a naked Fire, with a Set of* Receivers R R R R, *and* Adopters d d. *The* Fire *being either upon the lower or the middle* Grate, a a, *the Matter may be thrown in at the Door of the Ring* B; *the whole Furnace ſupplying the place of a* diſtilling *or* ſubliming Veſſel. *When the Fire is upon the loweſt* Grate, a, *the Neck of the diſtilling Veſſel comes out at the Door of the* Body C, *ſtanding on the* open Foot, E.

See Eſſay, *Pag.* 17, and 18.

When the Cover, A, *is inverted into the open* Foot, E, *it makes a commodious* Furnace *for diſtilling* per deſcenſum; *as expreſs'd in the Side-Figure* A E.

See Eſſay *Pag.* 19. *and Plate* II.

An Essay for Introducing a Portable Laboratory, &c.

SECT. I.

PRELIMINARIES.

THE intention of this Eſſay is to facilitate and promote the Practice of *Chemiſtry*, by putting a commodious *Laboratory* into the hands of Gentlemen; with ſome familiar Directions for its Uſe and Application. *The Deſign.*

But as the Advantages of the *Laboratory* cannot be underſtood without ſome previous knowledge of the *Art* intended to be practiſed with it; we ſhall here, by way of *Preliminaries*, give a ſhort View of *Chemiſtry*; and the general manner of exerciſing it to advantage.

Chemiſtry is of a very extenſive nature; ſo as to enter the whole Circle of *Arts* and *Sciences*; whence it may be conceived as an effective or practical kind of *Philoſophy*, that greatly contri- *Nature of* Chemiſtry

butes to ſet on foot and promote the active Buſ
neſs of the World.

The *Art* indeed has hitherto been little co
ſider'd in this Light; but 'tis time to advance
beyond an infant ſtate, and introduce it farthe
into human Affairs.

The Works of *Lully*, *Valentine*, *Hollandus*, *P*
racelſus, *Helmont*, *Glauber*, and the generalit
even of the more eminent Chemiſts, do not ſhe
us the true nature and genius of *Chemiſtry*; o
the direct manner of applying it to the improv
ment of uſeful Knowledge, Arts, Trades, an
the Buſineſs of Men. Thoſe Authors either ha
not the neceſſary Tempers or Talents for the pu
poſe; ſome of them wanted generoſity and frank
neſs, others a due compaſs of knowledge, othe
a clear and intelligible way of delivering them
ſelves; and moſt of them wanted a Tincture o
the true Philoſophy and Geometrical Reaſoning
ſo that in general they have amuſed, perplexe
and puzzled themſelves, as well as their Readers
and thus render'd a plain and rational *Art* di
agreeably intricate and forbidding.

Its uſe to Philoſophy. But the happy Philoſophical Temper and Ta
lents of Mr. *Boyle*, have clear'd us of this emba
raſſment; and ſhewn how *Chemiſtry* may be fami
liarly practiſed to advantage: his diffuſive know
ledge and ſober reaſon has ſettled the Art upo
its true foundation; and directed the applicatio
of it to the nobleſt uſes. He has ſhewn, by a
illuſtrious example, the method of introducing
ſound Philoſophy into the *Laboratory*; and there
applying it to buſineſs, the promotion of Arts
and every kind of uſeful ſcience *. And per-
haps

* Illuſtre illud Angliæ decus *Robertus Boyle*, unicus fere
eminet, qui chymiam paulo ſubtilius excolere; eamque rationa-
lem reddere in operibus ſuis, auro cedroque dignis, allaboravit
Frid. Hoffman. Obſervat. Phyſico-chymic. in Præfat.

haps there is no better method than this, diſcoverable by human means, for the advancement of Philoſophy it ſelf, and the practical Inventions of Men.

Thus, the common Philoſophy of our times is often explain'd, illuſtrated, confirmed, improved, and in ſome caſes ſhewn inſufficient by the proper uſe and application of *Chemiſtry*; whoſe peculiar province it is to diſſolve Bodies by Art, change their texture, and give them new properties, forms, and appearances. For example, it can readily change the colours, taſtes and odours of various Concretes; render fix'd Bodies volatile, volatile Bodies fix'd; turn Fluids into Solids, Solids into Fluids; corroſive Bodies into Neutrals, and Neutral into corroſive Bodies; with numerous inſtances of the like nature; and all this by means of certain Operations, the cauſes whereof are in the hands of the Artiſt: Whence the *Furnace* becomes an admirable Engine for *Philoſophical Inquiries*. And accordingly, the uſes which Mr. *Boyle*, M. *Homberg*, Dr. *Stahl* and ſome few others have made of it, open to us a new Scene of things; and ſhew the ſyſtem of the World it ſelf to be a kind of *Laboratory*, where infinite Operations are at once carried on without confuſion.

And whoever deſires to ſucceed in *Philoſophical Chemiſtry*, wou'd do well to imitate the Authors juſt now mentioned; both in the buſineſs of experimenting and reaſoning upon it; which they purſue in a calm, geometrical manner, from *Data* to *Quæſita*; having previouſly form'd to themſelves a kind of *Chemical Algebra*, whereby they ſoon find whether a Problem be ſolvable, and in what manner its ſolution ſhou'd be attempted. The excellence of *Chemiſtry* lies not in hurry and multiplicity of Experiments; but

in a ſedate and orderly performance of Operations, with particular views; and coming at the end by the ſhorteſt means: all along obſerving the Phænomena, ſo as to give a ſatisfactory cauſe of the effect; and ſhew how the diſcovery may turn to advantage.

Chemiſtry practiſed in this diſcreet manner, ſeems capable of anſwering any expectation that can be rationally entertain'd of it: but it will conſtantly perform leſs in proportion, as it recedes from ſo fundamental a Rule. This may appear by comparing together any number of chemical Authors; who are always found to ſucceed beſt in the improvement of the *Art*, as they had a greater compaſs of knowledge, and a cool philoſophical head. For example, let *Boyle*, *Homberg*, and *Hoffman*, be compared with *Becher*, *Kunckel* and *Glauber*; and the difference will preſently appear, together with its cauſe.

The Chemical Analyſis of ſo ſimple a *thing* as *Nitre* led Mr. *Boyle* into the mechanical Explanation of *Fluidity* and *Firmneſs*, *Volatility* and *Fixedneſs*, *Corroſiveneſs* and *Corroſibility*, *Taſtes* and *Odours*, and the nature of *Forms* and *Qualities* in Bodies; all which he has given with that perſpicuity and elegance, as cannot but recommend *Chemiſtry* to all that are concern'd for the improvement of Philoſophy *: But *Becher*, with great Talents and a warmer Head, has run thro' many branches of *Philoſophical Chemiſtry*, in a very laudable indeed, but leſs diſtinct and perſpicuous manner †.

By means of the *burning Lens*, M. *Homberg* has ſhewn, that *Gold* and *Silver* are as volatile at the Fire of the Sun, as the other Metals are in our common Furnaces; and adds much light to the *Art*, by teaching how this new Furnace may pave

* See *Boyle* Abridgm. Vol. I. † See Phyſic. Subterran. &c.

pave the way to a new Philoſophy, as the Microſcope and the Air-pump have done in their turns *: Whilſt *Kunckel* has improved and enriched *Neri*'s Art of Glaſs, with ſeveral new Diſcoveries that required leſs Genius, and much ſlenderer Abilities †.

Dr. *Frideric Hoffman* has given us a collection of ſolid and uſeful obſervations, founded upon large experience, in ſeveral parts of common and philoſophical Chemiſtry: But *Glauber*, an indigeſted heap, or rhapſody of improvements, many of them hypothetical, or built upon ſlight foundations ‖.

But for ſolidity of judgment, and true attachment to Obſervation, Experiment, and Geometrical Reaſoning, in the *ſublimer Chemiſtry*, Dr. *Stahl* at preſent ſeems to ſtand without Competitor **.

Its uſe to Arts.

And as *Chemiſtry* is thus ſerviceable to the purpoſes of *Philoſophy*, it muſt neceſſarily be as ſerviceable to *Arts*; which are nothing but Philoſophy reduced to practice, for ſupplying the neceſſities and conveniences of Mankind.

That the *rational Art of Medicine* has an entire dependance upon *Chemiſtry*, is fairly ſhewn by that great Profeſſor of both, the learned *Boerhaave* ††; and confirm'd by the authority of Dr. *Hoffman* ‖‖. The natural ſtate of a living body, or what paſſes therein, cannot be known without its aſſiſtance. The digeſtion of the Aliment, its converſion into Chyle, Milk, Blood and Lymph; the generation and office of the Bile; the origin of Salts and Oils in the Blood; the

* See *Memoir de l'Academ. An.* 1702.
† See *Obſervation. Phyſico-Chym.*
‖ See *Glauber. Opera Univerſa.*
** See *Opuſc. Chymico-Phyſico-Medic. Stahlij.*
†† See New Method of Chem. pag. 194.
‖‖ See *Obſervat. Phyſico-Chym. in Præfat.*

the great tendency of all the parts of the body to Putrefaction ; with numerous other Phænomena and Effects, require chemical explanations, before they can be ſatisfactorily underſtood.

Nor are diſtempers to be known and rationally cured without the ſame aſſiſtance. That an imperceptible quantity of matter, introduced into the body ſhould cauſe the plague, ſmall-pox, venereal diſeaſe, *&c.* could hardly be conceived without ſome acquaintance with *Chemiſtry* ; which gives a clear ſolution of the thing, and often points to the remedy. And in this light the venereal Diſeaſe has been lately conſider'd by a very eminent chemical phyſician, in the *new thoughts* he gives us, by way of preface, to an Edition of the antient authors upon the ſubject.

Pharmacy is capable of receiving great improvements from *Chemiſtry* ; tho' indeed this branch of medicine wants a reviſal, to ſhew how far the virtues of Simples may be extracted for medicinal uſe, and how far the Simples had better be given in their crude or natural ſtate. This however is certain, that many of them may have their eſſential and more efficacious parts ſeparated from the noxious and leſs uſeful, by means of *Chemiſtry* ; and thus be reduced to a commodious form for practice. In particular, a noble *Extract* may be chemically prepared of the *Bark* ; ſo as to contain the full virtues of the concrete, without its woody part ; which is many times the cauſe of obſtructions and other diſorders charged upon the uſe of this remedy.

As for the *Mechanic Arts*, the greateſt part of them depend almoſt totally upon *Chemiſtry* ; which either furniſhes them with Tools and Utenſils, Subjects or the Proceſſes themſelves. Thus all *Metals* are the genuine productions of *Chemiſtry* ;

miſtry; whence tools and utenſils for all kinds of buſineſs. The *Art of Glaſs* is a mere *chemical Art*, both in its Subjects and Proceſs. Various Pigments are produced by *Chemiſtry* for the uſe of the *Painter*; and various *Colours* for the uſe of the *Dyer*. *Salt*, *Alum*, *Soap*, *Vitriol*, *Sugar*, *Lime*, *Brick*, *Plaiſter*, *Wines*, *Brandies*, and moſt of the *ſtaple Commodities of* Europe, are of the ſame origin.

Thus, if we ſingle out any particular *Arts*, we ſhall generally find that their riſe and improvements were owing to ſome chemical Diſcovery, or Application. To inſtance in the *Art of Sugar*; had it not been for a chemical expedient, to make the boiled Juice of the Sugar-Cane Grain, and bring it to a dry form, we muſt have been contented to have uſed a Rob, or a kind of *Treacle*, inſtead of *Sugar*; as it is ſaid they do in ſome parts of the *Eaſt* to this day, for want of the *Art of Graining*. And it has been found, not only in *England*, but alſo in *Germany* and *France*, that the greateſt improvements in the *Art of refining Sugar*, have been made by ſuch as were directed and influenced by ſome previous chemical knowledge.

Nor is *Chemiſtry* leſs uſeful in the way of *Trade and Commerce*; as it teaches the beſt methods of packing and ſecuring Goods of all kinds; reducing them to their leaſt dimenſions; and preſerving them from the accidents of the weather, the Sea, and the like. Thus, for inſtance, it ſhews the way of reducing all *Ores* to their *Metals*, *Refuſe-wood* to *Pot-aſh*, *Spices* to their *eſſential Oils*, *Brandies* to *Alcohol*; the method of condenſing Wines, or bringing all their eſſential parts into a fourth of the whole, *&c.* At the ſame time this *Art* directs the Package, Fuſtage or Futail, proper for every Commodity, from pre-

previouſly knowing what Bodies are diſſolvable, and what undiſſolvable by others. Thus, to give an obvious inſtance, as *Treacle* is very ſubject to waſte, on account of the property it has of penetrating and diſſolving the reſinous ſubſtance of the Cask, this cannot be eſteem'd its beſt kind of Futail; whence we are directed to look out for another.

And laſtly, for the *Service of a Family*, nothing ſeems better fitted than *Chemiſtry*; as it directs and teaches all the ways of making *potable liquors*, *preſerving Meats*, *diſtilling Waters*, *waſhing*, *cleanſing*, *varniſhing*, *and preſerving Goods* of all ſorts; and enters at once the whole buſineſs of the *Kitchen*, the *Laundry*, the *Store-room*, the *Dairy*, the *Granary*, and the *Cellar*.

An *Art* of ſuch extenſive benefit might bear to be warmly recommended, eſpecially ſince the generality ſeem little appriz'd of the nature and uſes thereof; but as in all the parts of *Chemiſtry*, a ſedate and ſober conduct is preferable to a warm and vigorous one, we ſhall leave the reader to his own cool reflections upon the farther uſefulneſs of this *Art*, and proceed to offer a few general directions for practiſing it to advantage.

The beſt way of practiſing Chemiſtry.

Thoſe who have but a ſlender notion of *Chemiſtry* are apt to fancy it ſomewhat myſterious, or at leaſt more difficult to acquire than many other practical Sciences; but a little farther acquaintance with it will ſhew it to be as eaſy as *practical Geometry*, or the common experimental *Philoſophy*, and obtainable by a moderate application. Nay, the great facility wherewith it may be learn'd hath occaſion'd many writers deſignedly to diſguiſe, perplex, and render it leſs intelligible; that only the *worthy*, as they call them, that is, thoſe who did not want their aſſiſtance, might be benefited by it: as if all Mankind

kind had not a common right to ſo uſeful a Branch of knowledge!

'Tis true, *Chemiſtry*, like other *Arts*, muſt be conducted by certain Rules, and cannot be conquer'd at once; or to ſay the truth, is never to be fully maſter'd by human Abilities: the uſes and applications of it being unlimited and endleſs, or its nature truly inexhauſtible. Yet, the common qualifications of Men, without any deep or intricate ſtudies, are ſufficient to carry one through an inſtructive and profitable courſe of it; tho' we ſhou'd never attempt the *Mercuries of Metals*, *Malleable Glaſs*, or the *Philoſophical Tincture*.

And ſuch a *Courſe* as this, any Man may proceed in; either by forming *Rules* to himſelf, or following thoſe preſcribed him by others. For, as the *Art* is practical, and not capable of being carried on under wrong management; the intelligent Operator preſently gains light from his own Errors, and inſtructs himſelf by his miſcarriages. And this method, when diſcreetly purſued, is the beſt and only effectual one of learning the *Art*: As it fixes and inculcates things on the Mind, better than verbal Inſtruction, or bare ocular Inſpection; and renders a Man intelligent and practically knowing in what he is about, at the ſame time that it procures him a talent and habit of working: which no Words, Deſcriptions, or Examples cou'd of themſelves poſſibly do. And accordingly the beſt *Chemiſts* have been form'd, and the greateſt Improvements made in the *Art*, by ſuch kind of procedure. All that Direction and Inſtruction can do in this matter, is only to give the firſt motion to the wheel, which muſt afterwards be turn'd by the hand of the Operator. *Chemiſtry* therefore cannot

not be a very difficult Art, which thus teaches it ſelf, and breeds its own Maſters.

To avoid the Dangers attending it.

The *Danger* indeed attending it is greater than the difficulty; and may regard the *Perſon*, the *Underſtanding* or the *Fortune* of the Operator. When a *Chemiſt* treats certain Bodies, whoſe properties he is unacquainted withal, or commits a miſtake in an Operation, the ſucceſs whereof has never been tired; he may ſometimes run the risk of breaking his Glaſſes, and being offended with noxious Fumes. But accidents of this kind are rare; nor is any man obliged to try dangerous experiments, or to ſearch after ſuch deſtructive or pernicious things as *Gun-powder* and *Poiſons*. And in caſe any uncertain Operation were to be gone upon, a little common prudence will provide againſt contingencies; ſo that the burſting of Glaſſes, or the unexpected eruption of Fumes, ſhall occaſion no farther miſchief. And as for the *general Operations of Chemiſtry*, the accidents to which any one of them is liable are expreſsly deſcribed and provided againſt by all good Authors. So that upon the whole, *Chemiſtry* is not more dangerous to the *Perſon of the Operator* than many other Arts, as particularly the *Art of Mining*, *Fire-works*, *Caſting*, *Building*, *Navigation*, *Air-pump Experiments*, &c. all which require to be practiſed with prudence and diſcretion.

The Study of *Chemiſtry* is alſo ſuppoſed to give a wrong turn to the Mind; and ſet the Brain at work upon impracticable Schemes and Projects: and in truth, there have been a great many wild *Chemical Projectors*. But this objection does not perhaps lie more againſt *Chemiſtry*, than Mathematicks, Divinity, and ſome other noble and rational Studies, which have likewiſe made the Head giddy: ſo that the fault is ra-

ther in the Men than the Study. Whence a crazy Brain ſhou'd never be directed to *Chemiſtry*; which of all things requires ſolidity, and is ever practiſed to beſt advantage, the more of plain natural Senſe and ſound Philoſophy is employ'd in it. Nor do the Ravings and Reveries of ſome ſanguine Chemiſts about their *Elixir*, reflect upon the *Art*, any more than many other idle Dreams about the *perpetual Motion* do upon the noble Doctrine of *Mechanicks*.

But tho' the Head may remain ſound, there are ſtill other inconveniencies into which generous Tempers and publick Spirits are eaſily betray'd, upon making a little acquiſition in *Chemiſtry*. When a few proceſſes have opened the Mind, and given a proſpect of a great and general Good to be procured by them, 'tis almoſt natural for mankind to form thoughts of extending the benefit, and reducing *Experiments* to *Works*. The World is ſo much obliged to this enthuſiaſtick kind of Spirit, that perhaps it ought not to be curb'd, otherwiſe than by the difficulties and diſcouragements it naturally meets with in the execution of large deſigns. 'Tis often an eaſy matter in *Chemiſtry* from ſingle Experiments to form Schemes of gainful buſineſs; but it requires a deal of Thought, Skill, and more than ordinary Abilities to erect a promiſing Operation into a profitable Trade. Nor does the great obſtacle to ſuch an advancement uſually reſt in the Art of *Chemiſtry*; but more immediately in the civil and moral Circumſtances of Men, which are much more difficult to be ſeen into and directed than a chemical Proceſs; eſpecially by thoſe who know but little of the Tempers and Paſſions of mankind. And indeed a large ſhare of ſagacity and caution is requiſite to prevent miſchevious Effects upon a Man's private Fortune, from the

imprudent Exerciſe, or raſh application of *Chemiſtry*: the Danger in this caſe being ſeldom ſeen till 'tis felt. And againſt this evil, an extenſive Knowledge, Sagacity, good Senſe, and a diſpaſſionate View of things, are the only Preſervatives.

A Habit of experimenting to be acquired

The Buſineſs of *experimenting in Chemiſtry*, or conducting the various Proceſſes thereof to advantage, is an eaſy task, compared with the former; as depending entirely upon the acquiſition of a habit for this kind of manual Operation: which is the common caſe of *Artizans* or *Handy-Craftſmen*, who are not born to adroitneſs and dexterity of the hand, but form it by time and application. A young Operator muſt not preſently expect to go through chemical Proceſſes in the ſame perfection as a Veteran; who might himſelf be no leſs foiled at a new Operation. It wou'd perhaps exceed the skill of a good *Chemiſt* to caſt a Piece of *Ordnance*, or make a *Sword-blade*; tho' theſe are Operations not very foreign to his ordinary Employment. But a beginning muſt be made; and perfection will come by degrees. In caſe of any failure, the cauſe ſhou'd be diligently inquired into; and the remedy found and apply'd. Thus for example, ſuppoſe a young Chemiſt, attempting to make the common *Pocket-Soop*, ſhou'd prepare a fine ſolution of animal Fleſh, and proceed to boil it, in a common Veſſel, over a common Fire, to its due conſiſtence; he wou'd find, before the Operation was ended, that contrary to expectation, his *Soop* turn'd black, nauſeous and empyreumatic. Upon inquiring into the cauſe of this, he will diſcover that his Fire was too ſtrong, or applied too near his matter, ſo as to ſcorch or burn it like a coal. This may put him upon applying the Fire to another parcel of the ſubject, thro' a certain medium, which will

not

not allow it to have the ſame effect: and thus he is directed to the *Balneum Mariæ*, where the thing will ſucceed to his wiſh. And the like method of reaſoning, caſting about and inventing ſhou'd be uſed in all ſuch failures; whereby at length the beſt ways of operating will be found, and the Habit of preparing Commodities in their utmoſt perfection procured.

In general, *Chemical Operations* require a length of time, and a good deal of patience; to which the *Chemiſt* muſt by all means inure himſelf. To haſten an Operation in many Caſes is to deſtroy the very end propoſed to be anſwer'd by it. Thus in the *Rectification* of Brandies, our ordinary Diſtillers ſometimes make their *Goods* worſe than the Malt-Spirit they pretend to rectify, merely thro' haſte and inadvertence.

In fine, the *Practice of Chemiſtry* requires nothing more than common Care, Conduct, Reaſon, and good Senſe, to direct each Proceſs, ſuitably to the nature of the Subject, and the intention of the Operator.

SECT. II.

Deſcription of the FURNACE, *its* APPARATUS *and* SUBJECTS OF OPERATION.

Deſign of the Laboratory.

A Principal Obſtacle to the general exerciſe of *Chemiſtry* in *England*, being the difficulty of procuring proper Furnaces, Veſſels, Utenſils and Materials for the purpoſe; a *Portable Laboratory*, ready fitted for Buſineſs, is here recommended to the Publick.

The

The Contrivance is ſuch, that not only *Courſes of Chemical Experiments* and *Operations* may be perform'd by its means; but Commodities be prepared, in a ſufficient quantity, to ſupply the Demands of a Family and Friends.

A thing of this kind was firſt attempted by that excellent Chemiſt *Johan. Joach. Becher*; to whoſe Labours we with pleaſure acknowledge our ſelves very much indebted.

Its Parts. The *Laboratory* conſiſts of three parts, *viz.* a FURNACE, an APPARATUS and a MATERIA CHEMICA.

The Furnace. The FURNACE is general, or fitted to perform every Operation of *Chemiſtry*, for private uſe; or even a little circle of buſineſs. It has four principal Members, which we call by the names of the *Cover*, the *Ring*, the *Body*, and the *Foot*; all of them diſtinguiſhable at ſight.

The general office and uſe of the Cover is to check, ſuppreſs and throw back the heat and flame, or prevent the fewel from ſpending it ſelf too faſt; as it otherwiſe wou'd do, with little effect in many Operations. For the action of *Fire* being not momentary, but ſucceſſive, the more it is kept in, and directed upon the ſubject, the greater its effect, or the more thriftily employ'd. In order to increaſe the Draught, and ſqueeze the *Air* more forcibly thro' the body of the Fewel, there is a *moveable Chimney* that may occaſionally be fix'd to the Orifice, left for that and other purpoſes, in the top of this *Cover* *.

The *Ring* is the Seat of numerous Operations; the ſubject to be acted upon by the Fire being frequently lodged therein: and in other Caſes it helps to enlarge the Furnace; and render it capable of Operations which it cou'd not otherwiſe perform. The

* *See Fig.* 1, 2, 3, 4, *and* 5.

The *Body* ſerves to contain the Fewel, and is the common *Seat* of the Fire. In many caſes of Fuſion, as in running Metals from their Ore, it performs at the ſame time the Office of a Crucible; and contains the ſubject, mix'd along with the Fewel, after the manner practiſed in the *Smelting-houſes*.

To this *Body* belong three ſeveral *Grates*, that may be placed at different heights therein, according to the nature of the Operation, and the diſtance required between the Subject and the Fire.

And laſtly, the *Foot*, whereof are two kinds, is not only of uſe in ſupporting the other parts; but alſo in receiving the Aſhes of the Fewel, and the melted matters, that by the Fire are made to flow, and run down into it. And thus performing the office of a Receiver, 'tis of ſingular uſe in collecting and preſerving ſubſtances that might otherwiſe be ſpilt or loſt.

Its Appurtenances.

The more immediate *Appurtenances* of this Furnace are *Fewel* and *Bellows*. The *Fewel* may be Charcoal; or as there is a contrivance for a vent and flew in the *Body* of the Furnace, common Sea-coal may be employ'd, and the Smoak directed up the Chimney of the Room, where the Inſtrument is to ſtand. Its Structure alſo is excellently fitted for a *Lamp*; which in many caſes, as particularly ſome curious Digeſtions and Calcinations, is highly convenient. And by this means alſo, may the Operations which wou'd otherwiſe require the *Athanor*, or a long continued uniform heat, be elegantly performed.

Its States.

It wou'd be tedious to ſhew how all the numerous *Operations* of Chemiſtry are performable by means of this Furnace; it may ſuffice, at preſent, to conſider the general ſtates or conditions into which the *Inſtrument* may be put for the prin-

principal of them; whence its uſefulneſs will appear to be uncommonly extenſive.

For Fuſion. The ſimpleſt ſtate of this *Furnace* is a combination of two parts; the *Body* and the *Foot*, which thus fit it for *Fuſion, by the naked Fire*; where the matter to be melted is mix'd among the Fewel, as in running the Ores of *Lead*, *Tin*, or *Iron*, for inſtance: which may thus, in the quantity of many pounds, be clearly ſeparated from their droſs, and purged for uſe, as exactly as at the *Mine-works*, or *Smelting-huts*; either with the aſſiſtance of *Bellows*, or without, as the nature of the *Ore* requires *.

By barely placing the middle *Grate* in the *Trunk*, the Inſtrument becomes a *melting Furnace for a Crucible*; wherein all the Operations that require a *Fire of Fuſion*, animated either by the *Air* or *Bellows*, are performable, with ſuch advantages as cannot be had in the common *wind* or *blaſt Furnaces*, uſually employ'd for this purpoſe.

Digeſtion, Diſtillation, &c. When only the *Body* of the Furnace, with its middle Grate is ſet upon the *Foot*, it anſwers all the ends of the common *Shop-Furnace* of the *Apothecary*, for Decoction, Inſpiſſation, Extraction, *&c.* and the purpoſes of a naked Fire for certain diſtillations, ſublimations and the like, which require ſo ſtrong a heat. It may, moreover, be readily converted into a *Balneum Mariæ*, an *Aſh-heat*, a *Sand-heat*, or a ſtill ſtronger for digeſtion, diſtillation, and ſublimation, by barely ſetting upon it a Pan of *Water*, *Aſhes*, *Sand*, or *Iron Filings* †.

And thus, ſeveral Operations, requiring the ſame kind of Heat may be commodiouſly carried on at the ſame time.

If inſtead of a common Pan, the *Ring furniſhed with its ſet of* POTS, be ſet upon the *Body*, with its

* *See Fig. 6.* † *See Fig. 7.*

its Grate, you have a *Furnace* fitted for Diſtillation in *Capella vacua*; where the Retorts are contain'd in the cavity of the *Pots*, and lock'd down therein, without any viſible medium between. By which means many Operations may be perform'd in the diſtillation and ſeparation of Bodies, that cou'd not be work'd upon to ſo much advantage in any other method. And thus, in particular, may the Rectification of the ſtrongeſt mineral *Acids*, be expeditiouſly perform'd, and with little expence *.

An *Iron Pan* placed in the room of the Ring, juſt mention'd, makes a *calcining Furnace*; where *Ores* may be roaſted, or *Antimony*, *Lead* and other metalline matters commodiouſly reduced to aſhes †. *Calcination.*

The loweſt Grate being uſed, either a *cold Still* or a *hot one*, as 'tis call'd, may be put into the *Body*, and work'd as in the common manner; with its proper Head and Refrigeratory. And thus may *cordial Waters* be readily made, Spirits rectified, eſſential Oils diſtill'd, *&c* ‖.

The application of the *Cover* to the *hollow Ring*, and ſometimes to the *Body* without the *Ring*, makes a proper *Reverberatory Furnace*; for *Cæmentation*, *Cupellation*, the *aſſaying of Ores*, and diſtilling by a *Fire of ſuppreſſion*, as 'tis call'd; that is, where Fire is placed above as well as below the Veſſel ‖‖. *Reverberation*, &c.

A *Furnace* of this nature has infinite advantages, not only over the common chemical *Furnaces* in uſe, but even over thoſe of the moſt celebrated ſtructure and contrivances; whether of *Glauber*, *Vigani*, or other eminent Chemiſts and Mechanics; as uſually anſwering particular ends, as well as general ones, better than other Furnaces made for one ſole end. *Advantages of the* Furnace.

* *See Fig.* 8. † *See Fig.* 9. ‖ *See Fig.* 10. ‖‖ *See Fig.* 11.

Its numerous uſes. Thus 'tis better fitted for the various uſes of *Glauber*'s *Philoſophical Furnaces*, and the higher Operations of *Metallurgical Chemiſtry*, than thoſe invented by *Glauber* for theſe very purpoſes. For example, to obtain a pure *Spirit of Salt* in plenty, *Glauber* orders the *Salt* to be thrown upon the Fire; and has contrivances to catch the riſing Vapour: but this is a tedious way, and turns to very little account in practice. Nor is the matter much improved by quenching the Coals in a Lixivium of Sea-Salt, and burning them for their fume: But all that can be expected in this affair may be had commodiouſly from the preſent Furnace; where the Fire being animated with Bellows, cauſes the Fewel to burn free and yield the Spirit much quicker; whilſt the Fire is fed, or the matter thrown in at the door of the Furnace, without any trouble or diſturbance to the Operation: and thus the Spirit is obtain'd as pure as this Proceſs will afford it *.

The ſame is to be underſtood of the metalline *Sublimations*, *Incerations*, *Cæmentations*, &c. of *Geber*, *Hollandus*, and thoſe vulgarly call'd the *Adepts*.

But there are beſides theſe, a great number of ſtill more curious, and philoſophical Experiments, that either cannot at all, or not ſo juſtly be perform'd in a *Furnace* of a different ſtructure; or with ſo great diſpatch and other conveniencies; as will be manifeſt upon a proper uſe and thorough acquaintance with the *Inſtrument*.

In the mean time, it may be obſerv'd, that this *Furnace* is fitted for *enamelling*, the *making of Paſtes*, *ſtaining of Glaſs*, the *preparing artificial Gems*, and performing abundance of other mechanical and philoſophical Experiments. 'Tis alſo of ſuch a nature, that any Artizan, who requires the uſe of Fire, may employ it in his

 buſineſs,

* *See Fig.* 12.

buſineſs, as others may for the offices of a Kitchen, and the common occaſions of a Stove; or for warming a Study in cold weather, heating a Vault, or the making Stove-Rooms, as in *Germany* and *Holland*.

And beſides thoſe already mention'd there are many other particular Applications of the ſeveral parts of the *Furnace*, which are left to be diſcovered occaſionally by ſuch as ſhall uſe it. Thus, for example, if any one ſhou'd deſire a *Furnace* to diſtil *per deſcenſum*, as 'tis call'd, the *Cover* of this Furnace affords a fine opportunity for that purpoſe; being barely inverted into the *Foot*, as may be ſeen in the Figure *.

The Apparatus of the Laboratory.

The *Apparatus* of a *Laboratory* ſhou'd be ſo ſuited to the performance of all *Chemical Operations*, as that nothing, which is not readily procurable, may be wanting when it comes to be requir'd in buſineſs.

The following is calculated for the general uſes of the *Portable Furnace*; and will ſerve in all ordinary Caſes, or common Courſes of *Chemical Exerciſes*. But for extraordinary purpoſes it muſt be farther improved or enlarged at diſcretion, according to the particular exigences and views of the Operator.

All *Chemical Apparatus* may be divided into remote and immediate, or ſuch as is preparatory to the Operations, and ſuch as is actually employ'd therein. The remote *Apparatus* of our *Portable Furnace* conſiſts of ſeveral particulars.

And firſt, as every *Chemical Operation* is to be perform'd in an exact or geometrical manner; good *Scales and Weights* are of abſolute neceſſity, for determining the quantity of the ſubject employ'd; weight being the true touch-ſtone of the quantity of matter in Bodies.

Scales.

* *See Fig.* 13.

Meaſures. But in common caſes, or where Water, and other Liquors of nearly the ſame ſpecific gravity with that, are employ'd, it ſhortens the work conſiderably to go by Meaſure; which, in Water nearly correſponds to weight: a Pint of common Water weighing a Pound. Hence a *ſet of Meaſures* are very commodious in Chemical Operations. But they muſt be uſed with diſcretion, and never be truſted in curious Caſes, or where the utmoſt exactneſs is requir'd. A *Pint of Quickſilver* weighs about fourteen Pounds; and a Pint of Spirit of Wine falls ſhort of a Pound.

Mortars. Again, as many ſolid Subſtances require to be reduced into ſmall Parts, before they can become proper ſubjects of Chemical Operations, there will be a neceſſity for *Mortars*, *Sieves*, *Raſps*, *Files*, *Hammers*, *Sheers*, and *Forceps*.

Shovels, Tongs, &c. Next to theſe come the *Inſtruments* uſed in the management of the *Fire*, ſuch as *Shovels*, *Hooks*, *Tongs* and *Blow-pipes*.

For charging the Veſſels with the ſubject matters of the Operations, are requir'd *Hollow-Shells*, *Horns*, *Tin-plates*, *Bruſhes*, *Hares Feet*, *Spoons*, *Spatulas* and *Rounds* to ſet certain Glaſſes on: And for emptying the Productions, *Hooked-Tongs*, *Cones*, *Ingots*, *Baſons*, *Funels*, and *Store-Glaſſes*; furniſhed with common *Corks*, *Wax-Corks*, or *Glaſs Stopples*, to be tied down with *Bladder* and *Leather*.

Funels and Glaſſes.

And in the laſt place come the *Inſtruments for making certain Utenſils*, as *Cores* for Muffles, and *Moulds* for Teſts, Crucibles and Melting-Pots; and *Iron Rings* for cutting Glaſſes, and the Necks of *Retorts*.

The more immediate *Apparatus*, or that directly employ'd in the *Operations* themſelves, are *Veſſels containing the ſubjects to be wrought upon*, as particularly *Glaſs-Eggs* and *Bodies* for Digeſtion,

ſtion, *Retorts* and *Receivers* for Diſtillation, *Blind-Heads* for *Bodies* in Sublimation, *Stone-Pans* and cut *Glaſſes* for Evaporation, peculiar *Spout-Receivers* and *Glaſſes* for Separation; *Strainers* for Percolation; *Paper* for Filtration; *Muffles* and *Teſts* for Cupellation; *Crucibles* for melting; *Pots* for cementing; and Lutings to cloſe the Junctures of the Veſſels. Retorts, Receivers, &c. Crucibles, &c.

A compleat ſet of theſe ſeveral Utenſils make the *Apparatus* of the *Portable Furnace*, and fit it for all the uſual *Operations of Chemiſtry*.

The *Materia Chemica*, that is the *Subjects* to be work'd upon, or immediately and materially employ'd in chemical Operations, is the next thing to be conſidered. *The* Materia Chemica *claſſed.*

This is a large Field, and comprehends all the natural Bodies of our Globe; which are all ſubject-matters of *Chemiſtry*. We can therefore only ſelect for a *Portable Laboratory*, and the uſes of our *Furnace*, ſuch of them as are moſt neceſſary or difficult to be procured; eſpecially at any diſtance from large trading Cities, and populous Towns.

This *Collection*, being diſtributed into proper Claſſes, will come into a ſmall Compaſs; and may be commodiouſly carried, either by Land or Sea, along with the Furnace and its Utenſils.

We attempt to range it under the three heads of Vegetable, Animal and Mineral Subſtances; and to fit it for general uſe. But if any one deſires to enlarge or improve his *Collection*, he might do well to obſerve ſome certain order, or proceed in the manner pointed out by *Becher*, in his ſubterraneal Phyſics *; as what was long practiſed by himſelf to advantage.

He

* *Phyſic. Subterran.* Becher. *Pag.* 187.

He endeavours to range all *Chemical Subjects* under eight general Claſſes, viz. *Metals*, *Minerals*, *Decompounds*, *Salts*, *Gums*, *Earths*, *Stones*, *Spirits and Oils*.

1. The Claſs of Metals contains *Gold*, *Silver*, *Copper*, *Iron*, *Tin*, and *Lead*, both in their natural and artificial State; that is, both in their Ores, and as they are ſeparated and purified for human uſes.

Add to theſe the artificial, compound or mix'd Metals, as *Pewter*, *Bell-metal*, *Braſs*, *Gun-metal*, *Pin-metal*, *Bath-metal*, *Wells-metal*, *Princes-metal*, *London-metal*, *white Copper*, *white Gold*, *yellow Silver*, &c.

2. Under *Minerals* are included *Antimony*, *Biſmuth*, *Zink*, *Marcaſite*, *Cobalt*; *Zaffera*, *Manganeſe*, *Arſenic*, *Orpiment*, *Realgar*, *Virgin-Mercury*, *native Cinnabar*, *Sulphur*, &c. and theſe both pure and in their natural Mine.

3. The *Decompounds of Minerals* include *Aurum Fulminans*, *Luna Cornua*, the *Calces of Gold and Silver*, *Ultramarine*, *diſtill'd Verdigreaſe*, *burnt Copper*, *Putty* or *calcin'd Tin*, *Sugar of Lead*, *Cadmia*, *Tutty*, *black Lead*, *red Lead*, *Litharge*, *white Lead*, *Glaſs of Lead*, *ſimple and martial Regulus of Antimony*, with its *Flowers*, *Glaſs*, *Cinnabar*, &c. the preparations of *Quick-ſilver*; as *artificial Cinnabar*, *Mercury-Sublimate*, *Præcipitate*, &c. And in the ſame manner may the Decompounds of vegetable and animal Subſtances be commodiouſly ranged.

4. The Claſs of *Salts* takes in *Sea-Salt*, *Nitre*, *Vitriol*, *Alum*, *Borax*, *Tartar*, *Sugar*, *Soda*, *Potaſh*, and the *compound ſaline Fluxes* for ſtubborn Ores. Add to theſe the tribe of artificial Salts, as *Tartarum Vitriolatum*, *Sal Enixum Paracelſi*, fix'd *Nitre*, *ſoluble Tartar*, *Terra foliata Tartari*, *Nitrum nitratum*, *Sal-ammoniac*, *Epſom Salt*, *Volatile Salts*, &c.

5. Under

5. Under *Gums* are ranked Pitch, Roſin, Turpentine, Wax, Camphire, Amber, Pit-coal, Jet, Bitumens, Balſams, and inſpiſſated Juices.

6. *Earths* take in Ores, waſh'd Ores, Sluds, Calces of Metals, Lime, Plaiſter, Gypſum, Chalk, Boles, Shells, Sands, and all thoſe commonly call'd *Earths*, whether calcarious or vitreſcible.

7. *Stones* include Flints, Pebbles, Quarry-Stone, Cryſtals, Talcs, the vulgar Stones, and all the Gems, from the Diamond to the Cryſtal and *Fluores Metallici* *.

8. Laſtly, under Spirits and Oils come *Aqua Fortis*, *Aqua Regia*, Oil of Vitriol, Spirit of Salt, Spirit of Nitre, Spirit of Sulphur, Spirit of Alum, Spirit of Vinegar, Spirit of Wine, Spirit of Urine, Spirit of Tartar, Spirit of Turpentine, Oil of Tartar *per deliquium*, &c. eſſential vegetable Oils, as of Nutmeg, Cinnamon, *&c.* expreſs'd vegetable Oils, as of Linſeed, Olives, Almonds, *&c.* The compound Oils, as Butter of Antimony, Unguents, Artificial Balſams, *&c.*

And the Laboratory ſet in Order.

And in this manner *Becher* adviſes the young Operator to procure for himſelf an *Alphabet of Nature*; that is, a ſuitable Collection of the *Materia Chemica*; and to proceed regularly with it, as he wou'd do in learning to read, by compoſing firſt ſyllables, then words, and laſtly diſcourſes out of his *Alphabet*; that is, forming theſe various bodies into Mixts, Compounds and Decompounds.

But to avoid miſcarriages, and prevent being impos'd upon, he farther directs an acquaintance to be cultivated with the productions of nature in

* *For farther Directions relating to this Affair, See Dr.* Woodward's *Collection of* Foſſils.

in their crude ſtate, or peculiar places of growth; where being firſt view'd and examined before they are gather'd or dug up, an exact knowledge of them may be procured. For want of which, Men otherwiſe of great ſagacity have ſometimes err'd in their Operations, by uſing a wrong, an adulterated or imperfect ſubject inſtead of the true; whence numberleſs complaints of failure and uncertain ſucceſs in the buſineſs of *Chemical Experiments*. For as it is a maxim in *Law*, that every Circumſtance affects and alters the caſe; ſo a miſtake in the leaſt circumſtance as to time, order, or the genuineneſs of the ſubject, may affect and alter a whole Chemical Operation *.

To this he adds another Caution, as to the making a prudent and ſufficiently copious collection, which being always ready at hand may prevent ſending to the *Druggiſt* at every turn; where perhaps the things demanded are either not to be had, or at beſt not without ſophiſtication: whence many Proceſſes intended, have been obſtructed, entirely prevented, or never brought to a trial.

But when the *Alphabet of Nature*, like the Letters in a *Printing-houſe*, is diſtributed and lodged in its proper Cells, it may readily be drawn out for uſe, as occaſion requires. And ſo much as a good collection of this kind facilitates the practice of *Chemiſtry*, and renders it pleaſurable; ſo much is it render'd irkſome and diſguſtful by the want of it. *Becher* ingenuouſly declares the ſatisfaction he receiv'd from the uſe of a well-appointed *Laboratory* in the following words. " 'Tis impoſſible to expreſs with how " little expence, and trouble, yet to what great " pleaſure

* *See* Becher's *Phyſic. Subterran. Pag.* 189.

" pleaſure and profit, numerous Experiments, " tho' of the moſt difficult kind, may be made, " when the Operator has all his matters " ready about him. I have ſometimes gone " through fifty different *Experiments* in a Day: " And even, whilſt I am writing, if any dif- " ficulty requiring an experiment ariſes, I im- " mediately get up, and make it; my mate- " rials for the purpoſe ſtanding at my elbow, " whilſt I ſit at my Desk: ſo that 'tis as agree- " able and eaſy for me to perform an Opera- " tion with the Furnace, as to deſcribe one with " the Quill *."

And this end we preſume may be anſwer'd, to general ſatisfaction, by the means of our *Portable Laboratory*.

SECT. III.

Directions for the application of the PORTABLE LABORATORY *to the improvement of* CHEMISTRY.

The manner of uſing the Laboratory.

THE *Laboratory* being procured and ſet in order, we come, in the laſt place, to direct the manner of uſing it, to advantage.

This View will lead us to sketch out ſome particular methods for extending and improving *Chemiſtry* it ſelf; or repreſenting it as an Art beyond expectation ſuited to the entertainment of Gentlemen, Philoſophers, Scholars and Perſons of employ.

* *See* Becher's *Phyſic. Subterran. Pag.* 190.

But all at preſent propoſed is barely to *ſhew* the Paths that lead to the immenſe Regions of *Chemical Knowledge*; without pretending to conduct the Reader thro' them, any farther than by pointing to ſome few of the principal Guides that may be ſafely follow'd in this purſuit.

Thoſe who are not yet informed in the common *chemical Proceſſes*, wou'd do well to conſult the learned *Boerhaave's new method of Chemiſtry*; which in a plain, familiar and geometrical manner, delivers an inſtructive and uſeful *Courſe* of *Operations*; all of them commodiouſly performable upon our *Portable Furnace*. And ſuch a Courſe appears to us a ſuitable Introduction to the *ſublimer Chemiſtry of Boyle, Becher, Homberg* and *Stahl*; and a good Foundation for its ſtill farther advancement.

For the improvement of Philoſophy and Arts.

Whoever wou'd proceed farther, may direct his *Chemiſtry* to the improvement of *Philoſophy, Arts, Sciences, Trade*, and *Commerce*; for the promoting of which end, we here offer a *few Schemes of Courſes*, which, with numerous others, are alſo performable upon our *Portable Furnace*.

Scheme

SCHEME for a Courſe of GENERAL CHEMISTRY:

OR,

An INTRODUCTION *to the ſeveral Branches of* CHEMICAL KNOWLEDGE.

In the WAY *of* SEPARATION.

I. THE common methods of *analyſing vegetable, animal and mineral Subſtances*; to ſhew the matters into which they are ſeparable by the artificial application of Fire; both in their natural ſtate, and after they have been alter'd by *Fermentation*, *Putrefaction*, or *Corruption*.

Hence an Explanation of the *Chemical Principles*; and a Notion of the chemical ſtructure of Matter, with its uſes in *natural Philoſophy* and *Arts*.

The beſt aſſiſtance in this affair ſeems derivable from Mr. Boyle's Sceptical Chemiſt, Becher's Subterraneal Phyſics, *M.* Homberg's Eſſays upon the Principles, *The numerous* Analyſes *of the* Royal Academy *of Sciences at* Paris; *or the Reſult of their Doctrine improved by M.* Homberg.

II. The manner of procuring the *Waters* and *eſſential Oils* of *Vegetables*, in perfection; or the HISTORY OF DISTILLATION *per Veſicam.*

The method of procuring *diſtill'd Waters*, *Brandies*, and *Spirits.*

The HISTORY OF CHEMICAL OILS; and their uſes to the *Perfumer*, the *Apothecary* and private Perſons.

The foundations for this Subject ſeem well laid by Boerhaave, *in his* New Method of Chemiſtry; *and Dr.* Hoffman *in his* Obſervationes Phyſico-Chemicæ. *There are alſo ſome occaſional Papers relating to it in the* Memoirs of the Royal Academy; *particularly by M.* Homberg *and M.* Geoffroy.

III. The ſimple *Solutions*, *Tinctures*, *Infuſions*, *Decoctions*, *Robs*, *Laques*, and *Extracts* of *Vegetables:* for the uſes of Brewing, the Art of Wines, the Art of Pharmacy, the Art of Dying, the Art of Painting, and the Service of a Family.

Hence the mechanical Philoſophy of *Solution*, *Extraction*, and *ſimple Mixture.*

Moſt of the common Chemical Authors have treated theſe Proceſſes, but without launching into the extenſive uſes thereof; as having chiefly confined themſelves to pharmaceutical views. Among the principal to be recommended upon this head are Glauber, Boyle, Becher, Kunckel, Le Mort, Homberg, Hoffman, *and* Boerhaave.

IV. The dry *Diſtillation* or *Sublimation* of VEGETABLES; whence the perfect manner of refining *Camphire*, and an experimental inquiry whether *Eſſential Oils* are convertible into *Camphire*, and *Camphire* into *Eſſential Oils*: with the uſes of this Diſcovery to Phyſicians, Apothecaries, Druggiſts and Chemiſts. *This*

This Subject has been little touched by Authors, and at preſent lies in a good deal of uncertainty; the Diſpute about the Nature, Production, and Refinement of Camphire remaining unſettled: as to which point, le Febure, *the Elder* Lemery, *and ſome late Papers in the* Philoſophical Tranſactions *may be conſulted, and compared with the opinions of Mr.* Boyle, Boerhaave, Homberg, *and other Members of the* Royal Academy *relating to this affair.*

V. The common Proceſſes of MALTING all VEGETABLE GRAIN, for *Potable Liquors*, and *Corn Spirits.*

Hence an Explanation of the Nature of ſeminal Vegetation; and an Introduction to the *Art of Brewing.*

Boerhaave *in his* New Method of Chemiſtry *has given an Introduction to theſe Proceſſes; but they have otherwiſe been little conſidered by Philoſophers or Chemiſts. There are however ſome Papers relating hereto, in the* Philoſophical Tranſactions, *that well deſerve to be conſulted.*

VI. The methods of fermenting MALTED GRAIN and VEGETABLE *Juices* into DRINKS, WINES, and VINEGARS; with the art of procuring and refining *eſſential Salts and* TARTAR.

Hence a rational Hiſtory of *vinous* and *acetous Fermentation*; the Diſeaſes of Wines, and their Cures.

Boerhaave *has open'd this Subject, in his* New Method of Chemiſtry; *but* Stahl, *in a peculiar Treatiſe, has carried it farther, with a view to* Philoſophy *and Practice. Some pretty Hints relating to it may likewiſe be found up and down in* Glauber, *Mr.* Boyle, *the* Philoſophical Tranſactions, *the* German Ephe-

Ephemerides, *Mr.* Evelyn, *the* Vinetum Britannicum, *Dr.* Merret, &c. *but Dr.* Stahl *has promiſed us a* practical Hiſtory of Fermentation ; *wherein we hope to ſee this Subject improved, according to his maſterly manner.*

VII. The Proceſſes for reducing VEGETABLE JUICES to SUGARS, by Expreſſion, Decoction, Clarification, Graining, Claying, and Cryſtallization.

For Directions in the ſeveral Proceſſes of this Art ſee Piſo's Hiſtor. Ind. Angelus Sala *in his* Saccharologia, *Dr.* Slare on *Sugars, and Sir* Hans Sloane's natural Hiſtory of Jamaica. *Add to theſe ſome Papers in the* Philoſophical Tranſactions.

VIII. The Method of procuring NITRE *from* VEGETABLES, and purifying it for *Gunpowder*, and other Uſes.

To this purpoſe ſee Glauber, Clarke, *and* Stahl *on* NITRE ; *and compare them with the Diſcourſe of the Younger* Lemery *upon the origin of this Salt.*

IX. The method of procuring VOLATILE SALT from VEGETABLES, for various uſes ; and fit to compoſe *Sal-Ammoniac* for the purpoſes of Dyers, Braziers, Apothecaries, and Chemiſts.

With this view, conſult the extraordinary Paper of Dr. Cox *upon the Subject of* Volatile Salts, *in the* Philoſophical Tranſactions ; Boerhaave's *Hiſtory of vegetable Putrefaction, and his Account of* Sal-Ammoniac ; *and compare them with the Papers of Meſſieurs* Lemery *and* Geoffroy *upon the manner of preparing this Salt in the* Levant, *and imitating it in other Countries, as well as* Nitre.

X.

X. The method of treating VEGETABLES for their *Wax*, *Honey*, *Gums*, *Tar*, *Pitch*, *Turpentine*, *Oil*, *Roſin*, and *Colophony*.

Some Accounts to this purpoſe are met with in the Writers of Travels and natural Hiſtory; but the Foundation of the thing may be ſeen in Boerhaave's New Method of Chemiſtry; Pomet, *and* Lemery's *Hiſtory of Drugs, or rather among the Writers of natural Hiſtory.*

XI. The method of charring VEGETABLES for Fewel, to burn without Smoke; and to be of uſe for the drying of *Malt*, and other curious, chemical, and oeconomical purpoſes.

Glauber, *Mr.* Boyle, *Mr.* Evelyn, Boerhaave's Chemiſtry, *and the* Philoſophical Tranſactions, *contain ſome Particulars to this purpoſe.*

XII. The art of reducing VEGETABLES to POT-ASH, for the Service of the Soap-maker, Fuller, Scourer, Dyer, Glaſs-man, Chemiſt, Apothecary, *&c.*

Glauber *in his* Proſperity of Germany, *and elſewhere, has ſome uſeful Obſervations relating to this Subject; which is alſo conſidered by ſeveral of our Naturaliſts: but the* chemical Foundation *of the whole may be readily learn'd from* Boerhaave's New Method of Chemiſtry, *or almoſt any good Writer of general Courſes.*

ANIMALS.

XIII. The common Reſolution of ANIMAL SUBSTANCES into their *Principles*, pure and mix'd for the uſes of *Medicine* and various *Arts*.

See Boyle's Hiſtory of Human Blood, *his* Sceptical Chemiſt, &c. *Dr.* Cox, Boerhaave's Proceſſes upon Animals, *in his* New Method

Method, *and* Stahl's *Philoſophical Pri*
of univerſal Chemiſtry.

XIV. The manner of ſeparating the mo
dicinal parts of ANIMALS, in the way of
Solution, Tincture, Jelly, *&c.* for the u
the Apothecary.

This Subject has been little treated in a P
phical View, but receives ſome light from
haave's *Proceſſes upon Animals*, Mr.
Experiments on human Blood, the Uſe of F
Digeſtor, and the common Pharmac
Chemiſtry.

XV. The manner of ſeparating and pur
the *Fat* of ANIMALS for the uſes of the
boiler, Chandler, Clothier, &c.

The difficulty here lies in taking off the n
Odour of coarſe, animal Oils, or Fat
rendering them fit for the finer uſes.
this affair, the methods delivered by
chemical Authors, for rectifying and pu
ſome empyreumatic Oils, may be of ſervic
Boerhaave's Chemiſtry.

XVI. The method of ſeparating the *Ph*
rus from ANIMAL SUBJECTS, and rec
them to *Black*, *Aſhes* and *Earth*, for th
of Printing, Colouring, Aſſaying, *&c.*

The whole Affair of the animal Phoſphc
accurately deliver'd by Mr. Boyle *an*
Homberg; *and the* Soot, Black, Aſhes
Earth, *are touched upon by* Boerhaave
thers.

MINERALS.

XVII. The *general Methods* of reducing
NERAL JUICES to a dry Subſtance, ſo

come at the ſolid Matter they contain, with a view to the *Art of* MINING, or the Diſcovery of *Metalline Veins*; the Erection of Salt-works, Vitriol-Works, Alum-Works, Borax-Works, *&c.*

This Subject is handſomely proſecuted by the learned George Agricola, *at the cloſe of his admirable Work* de Re Metallica: *and the view is carried farther by Mr.* Boyle, Becher, Stahl, Homberg, *and ſome other Members of the Royal Society, and* French *Academy.*

XVIII. The manner of reducing ſolid MINERAL SALTS to fluid *acid Spirits*, by Separation or Diſtillation, for the numerous uſes of Dying, Etching, Aſſaying, the Preparation of Menſtruums for Metals, and many other Subjects.

The Proceſſes for this purpoſe are deliver'd by all Writers of chemical Courſes; but the Rationale, and the juſt Application of the Productions to mechanical, philoſophical, and chemical uſes, are ſparingly touched upon by them. Thoſe who wou'd go deeper in this affair, may conſult Boerhaave's New Method of Chemiſtry, *Dr.* Stahl's Philoſophical Principles of Chemiſtry, *Mr.* Boyle's *Eſſay upon Nitre, and M.* Homberg's *Paper on* acid Spirits. *Add to them* Agricola de Re Metallica, *and others who have wrote upon the buſineſs of Aſſaying.*

XIX. The general method of analyſing *ſolid* MINERALS; or reſolving them into *Flowers, Sulphur, Arſenic, Earth* and *Metal*; or any other particular Subſtance they may contain; with a view to *philoſophical Minerology*, and the vulgar *Art of Metals*; or the procuring all *mineral Subjects* in their pure, ſeparate, and artificial ſtate.

Thoſe who deſire to ſee how this buſineſs is treated at the Mines, may find an entertaining account of it in George Agricola's *noble Work*

de Re metallica. *There is alſo a good deal to the ſame purpoſe delivered up and down in the Writings of* Paracelſus, Helmont, Glauber, Ercker, *and Mr.* Boyle. *But among the capital Performances in the philoſophical and chemical parts of this affair ſtands that of* Becher, *call'd his* Phyſica ſubterranea, *eſpecially as it is now improved by the Labours of Dr.* Stahl.

The Deſign of this Courſe *has hitherto been to ſhew the general manner of ſeparating from* chemical Subjects, *whether* vegetable, animal, *or* mineral, *the diſtinct, ſimilar, or homogeneous parts that enter their Compoſition; ſo as to procure them ſimple and fit for uſe. All theſe Productions therefore are ſo many* artificial Creatures, *obtain'd by a chemical Reduction of natural* Bodies; *which, as well as the artificial ones, may be compounded and recompounded by* Art, *like the Letters of the Alphabet, into many thouſands, nay millions of new and unknown Bodies; all of them* Creatures of Chemiſtry: *which ſhews the prodigious power and extent of this Art.*

In the way of Combination.

Among the Experiments relating to the *Combination* of *Vegetables* with *Vegetables*; may come,

XX. The ways of combining *eſſential Oils* with *vegetable Waters*, Sugars, and inflammable Spirits, for various uſes.

See Boerhaave's New Method, *and* Stahl's Philoſophical Principles of Chemiſtry.

XXI. The methods of combining *vegetable Oils* and *vegetable Salts* into *Soaps*, and the *Sales volatiles oleoſi*; for the purpoſes of Medicine, a Family, and many mechanical Trades.

Conſult

Conſult upon this head, Starkey *on the Soap of Tartar,* Boerhaave's New Method of Chemiſtry, *and* Homberg's *Paper deſcribing a particular* Soap *for taking away Freckles.*

XXII. The *Ways* of combining fix'd and volatile VEGETABLE SALTS with *vegetable Acids*; ſo as to make artificial *neutral Salts* of ſingular virtues and uſes.

Many curious Particulars relating to this purpoſe, are found in Mr. Boyle's *philoſophical Works,* Boerhaave's *Chemiſtry, the* French Memoirs, *and the Philoſophical Tranſactions.*

XXIII. The method of combining inflammable Spirits with *vegetable Acids,* and with Roſins, for medicinal and mechanical uſes, in the art of Wines, Brandies, and the making of compound Varniſhes.

This Subject receives ſome light from the common Proceſſes of Chemiſts for dulcifying acid Spirits; and making the ordinary Tinctures: but its more extenſive uſe muſt be derived from the philoſophical Chemiſts, as Boyle, Homberg, Boerhaave, *and thoſe who deſcribe the arts of Diſtillation and Japanning.*

Experiments relating to the COMBINATION *of* VEGETABLES *with* ANIMALS.

XXIV. The *method* of combining *animal and vegetable Salts,* and *Roſins* with *Alcohol,* Spirit, Wine, Vinegar, or Water; for the uſes of Pharmacy and other Arts.

The common chemical Books are full of Proceſſes to this purpoſe, as Le Febure, Le Mort, Lemery, Wilſon, Barchuſen, *and* Boerhaave.

XXV. The ways of combining *fix'd Salt* and *animal Fat* into *Soap*; Blood and fix'd Salt into a

blue Pigment; animal Fleſh and vegetable Balſams into *Mummy*; with other particulars of this nature.

See Boerhaave's Chemiſtry, *and the* Philoſophical Tranſactions.

Experiments relating to the COMBINATION *of* ANIMALS *with* MINERALS.

XXVI. The method of combining various *Minerals* with *Animal Oils*, and *Fats*, into Unguents, Plaiſters, and Paints.

The common Diſpenſatories have the Proceſſes for this purpoſe, but the Philoſophy of them muſt be derived from chemical Authors; as particularly Boyle, Becher, *and* Boerhaave.

XXVII. The method of recompounding or reſtoring the Calces of Metals, by the addition of a little *animal*, or *vegetable Fat*; whence an experimental inquiry into the *Phlogiſtic Principle* of Dr. *Stahl*; with its uſe in the Buſineſs and Philoſophy of Metals.

XXVIII. The way of rendering Alkaline *animal* Salts neutral, or turning them into *Sal-ammoniac* by combining them with the Spirit of Sea-Salt.

See the Diſpute betwixt Geoffroy *and* Lemery, *about the preparation of Sal-ammoniac, in the* French Memoirs.

Experiments relating to the COMBINATION *of* VEGETABLES *with* MINERALS.

XXIX. The ways of combining *vegetable Salts* with *mineral Sulphurs*; whence the Separation of Metals from their Ores, and the Production of numerous kinds of *Slags* or *Scoriæ*; with their chemical and philoſophical uſes.

Upon this head conſult Agricola de Re metallica, Ercker, *and other Chemical Writers upon Mines*

Mines and Minerals: But particularly Boerhaave *in the* chemical Hiſtory *of Antimony*; *and* Stahl *in his ſeveral pieces of* metallurgical Chemiſtry.

XXX. The ways of combining fix'd *vegetable Salts* with *mineral Earths*; whence the foundation of the *Art of Glaſs*, and the *Art of Metals*; with the Philoſophy of *Vitrification* and *Metallization*.

See upon this head Boyle *of Gems*; Neri's *Art of Glaſs*, *with* Kunckel's *Notes*, *and* Stahl's *curious Pieces of metallurgical Chemiſtry*; *as alſo his Comment upon* Becher's *Subterraneal Phyſics*.

XXXI. The ways of combining *metalline Matters* with *vegetable Liquors*; whence many medicinal Tinctures or Solutions of Metals, and the whole buſineſs of INKS.

See Boerhaave's New Method of Chemiſtry, *and* Homberg's *Experiments upon this Subject*, apud du Hamel in Hiſtor. Academ. Regal. Pariſienſ.

Experiments relating to the Combination of MINERALS *with* MINERALS.

XXXII. The ways of combining the MINERAL ACIDS with METALLIC MATTERS; whence the numerous Tinctures, Solutions, Sublimates, Præcipitates, Calces, *&c.* of *Gold*, *Silver*, *Mercury*, *Lead*, *Iron*, *&c.* with their extenſive uſes.

All the chemical Authors have more or leſs treated this copious Subject.

XXXIII. The general ways of combining *Minerals* with *Metals*, as *Sulphur* with *Iron*, *Arſenic* with *Gold* or *Silver*; *Calamy* with *Copper*, *&c.* whence various diſcoveries as to the Philoſophy of Metals;

and the natural Compoſition of Ores and mineral Subſtances; which are thus imitated or prepared by Art.

See upon this head Becher *and* Stahl *in particular.*

XXXIV. The Art of combining *Metal* with *Metal*; in the way of *Electrum*, and making the artificial or mix'd Metals.

Much light is given to the philoſophical part of this buſineſs, by Mr. Boyle *and M.* Homberg; *tho' the practical part of it has generally fallen into mere mechanical hands. But* Agricola, Ercker, Glauber, Becher, Boerhaave, *and* Stahl *ought to be conſulted upon it.*

Experiments relating to the Combinations of Subjects of the three KINGDOMS *promiſcuouſly.*

XXXV. The Combination of Nitre, Coal and Sulphur into Gunpowder; fix'd *vegetable Salt*, *Sand* and *Metal* into Glaſs of all Colours; Nitre, Salt of Tartar, and Sulphur into the *Pulvis Fulminans*; *Sal-Ammoniac*, and *Quick-lime* into a certain Phoſphorus; Alum, Wheat-Flower, or other vegetable or animal Subſtances, into the common *black Phoſphorus:* with numerous Examples of the ſame general nature.

And in this view all the original chemical Authors ſhould be conſulted; not omitting even thoſe called the Adept, from Hollandus, Valentine, Lully, *Friar* Bacon, Paracelſus, Helmont, &c. *down to* Boyle, Philaletha, Becher, Homberg, *and* Stahl. *Add to theſe, the Authors who have wrote upon particular Trades, requiring the joint aſſiſtance of all the three Kingdoms.*

XXXVI. *Experimental Attempts* to direct the farther Combination of Subjects and Productions of all the three different Kingdoms, with a view to diſcover

diſcover new *Solvents*, or Mixtures for the purpoſes of Medicine, the mechanic Arts, and the farther uſes of Mankind.

Little in this way has hitherto been done by any ſingle Author; and indeed a Work of that kind requires the joint Labour of Colleges of Men. But Mr. Boyle *and* Boerhaave *have open'd the Affair, and certain Members of the Royal* Academy *and Royal Society have purſued it. See* Boyle paſſim, *and* Boerhaave's *Chapter of Menſtruums.*

XXXVII. *Experiments* relating to the re-compoſition of Bodies, or combining their ſeparated Principles together, ſo as to compoſe the original Concrete again.

See Mr. Boyle's *capital Experiment upon Nitre, M.* Homberg's *Eſſays; and Dr.* Stahl, *both in his Philoſophical Principles of univerſal Chemiſtry, and his* Opuſculum Chymico-Phyſico-Medicum.

SCHEME

SCHEME for a Cour
PHILOSOPHICAL CHEMISTR

OR,

The Application of Chemical Ex
ments to the Improvement of
TURAL KNOWLEDGE.

I. AN *experimental Inquiry* into the *
Nature, and internal Structure
ter, in the different Aggreg
Maſſes of Animals, Vegetables, and Mi
compared with the Experiments and O
tions of *Boyle*, *Becher*, *Hook*, *Newton*, a
other Members of the *Royal Society* and
Academy.

II. An *experimental view* of the variou
and forms into which Matter is reducible b
miſtry; as to Fluidity and Solidity, I
tions, Vapours, Heat, Cold, Gravity, I
Hardneſs, Softneſs, Colour, Conſiſtence,
&c.

In this particular Mr. Boyle *has perfor*
mirably; and ſeems in a manner,
engroſs'd the Subject to himſelf.

III. A View of the different RELATIONS, vulgarly call'd *Sympathies* and *Antipathies*, or *Attractions* and *Repulſes*, obſerv'd betwixt different chemical Bodies; with the uſes of this Doctrine in *Philoſophy* and *Chemiſtry*.

See Boyle, Hook, Homberg, Newton, Stahl, *and the* Memoir *of* Geoffroy *in the Works of the Royal Academy for the Year* 1718.

IV. An *experimental Enquiry* into the real *Principles* of natural Bodies; how far the Fire gives a juſt Analyſis, and how far it fails therein. Whence the Doctrine of chemical Separation and Combination may be adjuſted.

Among the principal Authors to be conſulted upon this head are Boyle, Becher, Homberg, *and* Stahl.

V. An *experimental Enquiry* into the buſineſs of *Mixture*, natural and artificial; or the beſt and moſt intimate manner of uniting Solid with Solid, Solid with Fluid, Fluid with Fluid, *&c.* according to the ends for which they are deſign'd.

Great light may be received in this Enquiry from the Works of Mr. Boyle, Becher's Subterraneal Phyſics, Stahl's *Comment thereon, and his* Paper *upon Mixts, Texts and Aggregates*; *publiſhed in his* Opuſculum Chemico-phyſico-Medicum, *and the* Obſervationes Hallenſes.

VI. A *Philoſophical Explanation*, and experimental Illuſtration of all the *Chemical Operations*, as ſo many means of effecting certain Changes in Bodies, according to certain Rules, for the various purpoſes and intentions of the Art.

Something of this kind was attempted by Dr. Freind, *in his* Prælectiones Chemicæ; *but the view is enlarged by* Boerhaave *and* Stahl; *yet well deſerves to be farther proſecuted, as it*

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IX.
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X. *Expe*
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Newton
Harris's

XI. A Set o
the general Nat
ments in the Syſt

This Article is nobly handled by Mr. Boyle, *reconſidered by M.* Homberg *and* Boerhaave; *and improv'd by Sir* Iſaac Newton.

XII. A Set of *chemical Experiments* to unfold the Nature of FIRE and HEAT; with the *Modus* of their Operation upon Bodies, for the Production of various Effects.

A Foundation for this Enquiry is laid by the Lord Bacon, *and improved by Mr.* Boyle, *M.* Homberg, Boerhaave, Lemery, *and a certain anonymous Author* de Igne.

XIII. A Set of *chemical Experiments* to diſcover the Ingredients of the ATMOSRHERE; and account for its various Effects, Operations, and Phænomena, with regard to Bodies lodged or digeſted therein.

This Subject alſo has been nobly proſecuted by Mr. Boyle; *and ſeems brought to a little Syſtem by* Boerhaave, *in his Chapter of* Air, *conſidered as a chemical Inſtrument.*

XIV. An *experimental Enquiry* into the Nature of WATER, its Office and Uſes in the Globe, the Origin of hot and cold Springs, the Saltneſs of the Sea, and the different kinds of mineral Waters.

See Mr. Boyle, Becher, Liſter, Boerhaave, Newton, Bernoulli, Stahl, *and* Hoffman.

XV. Experiments to ſhew the nature and uſes of EARTH, conſidered as an Element.

Among the beſt Guides in this Affair muſt again be reckon'd Boyle, Becher, Boerhaave, Newton *and* Stahl.

XVI. Attempts to imitate various *Phænomena* of the ATMOSPHERE, as Thunder, Lightning, Coruſcations, the *Aurora Borealis*, Water-Spouts, Rain, Hail, Snow, *&c.*

XX. Experiments relating to the *Cauſes* and *Cures of Diſeaſes*, or the Diſcovery of peculiar medicinal *Solvents* or *Specificks*.

Conſult upon this head Mr. Boyle's *Diſcourſe of ſpecific Remedies*, Boerhaave's Chapter of Menſtruums, *and certain Papers in the* French Memoirs, *attempting to diſcover Solvents for the* Stone *in the Bladder*, &c.

XXI. Experiments to determine *à priori* the Nature and medicinal Virtues of MINERAL WATERS.

See Mr. Boyle *upon this Subject, aud compare him with Dr.* Hoffman; *by which means alone a ſolid Foundation may be laid, for this otherwiſe uncertain Affair.*

XXII. An Attempt to introduce ſome *new Inſtruments* into *Chemiſtry*, for the more exact Performance of certain Operations, both in the way of *Separation* and *Combination*; particularly the inſtrumental Agency of COLD, and the powerful Furnace of the SUN.

Upon this head conſult the Lord Bacon, *and Mr.* Boyle; *and with their Diſcoveries compare the Experiments of M.* Homberg *and Dr.* Stahl, *as to the effects of high degrees of* Cold *and* Heat *in chemical Operations.*

XXIII. An Attempt to explain the *Chemiſtry of Nature*, or ſhadow out the manner wherein the World is continually recruited in all its Parts; the Earth refreſh'd with Dew and Rain; the Atmoſphere ſtored with Vapours, and the Seeds of Vegetables; Vegetables ſwelled with Moiſture, and expanded by the Heat of the Sun; the Air furniſh'd with its renovating Spirit; and Fire, Air, Earth and Water conſerved to repair the animal, vegetable, and mineral Worlds, and pre-

preſerve the divi
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Hook, *M.*
haave, *and*

A SCHEME for various Courſes of TECHNICAL CHEMISTRY:

OR,

The Application of Chemical Experiments to the Illuſtration of ARTS *and* TRADES.

WE are now entering upon a wide Field, little frequented by *Philoſophers*; the *Mechanic Arts* being uſually eſteem'd rvile, or below the notice of Gentlemen and cholars; to the great prejudice of *Chemiſtry*, id *natural Philoſophy:* So that the little Knowdge we have ourſelves acquired in Trades, has ther been picked up occaſionally, by conrſing with Workmen, and viewing their Permances, than extracted from Books of partilar Arts; wherewith *England* is ill furniſh'd, we ſo unhappy as to have ſeen but few of m. And thoſe too are generally ſuch as we not heartily recommend; being either wrote mere Mechanics and Operators, without any l in Philoſophy; or collected with little ice and Judgment. Thus *Salmon*'s *Polyhice* is vulgarly eſteem'd a capital *Engliſh* rk in this way; tho' a faulty and iniudicious

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proper Collection of chemical Experiments they may be readily explain'd; and their Nature, Uſes, and Manner of operating ſhewn; at leaſt in a general way; ſo as to give an Idea of the philoſophical Method of applying Chemiſtry to the Diſcovery and Improvement of Trades: the greateſt part whereof might occaſionally be drawn out, and ſet to fuller view, by particular Schemes of COURSES; as in the following *Examples*.

Aggregation, Solution, Coagulation, Evaporation, Cryſtallization, Præcipitation, Sublimation, Diſtillation, Digeſtion, Detonation, Candefaction, Fuſion, Incineration, Calcination, Deliquation, Regeneration, Congelation, and *Fermentation*; of various kinds, with direct relation to *Pharmacy.*

II.

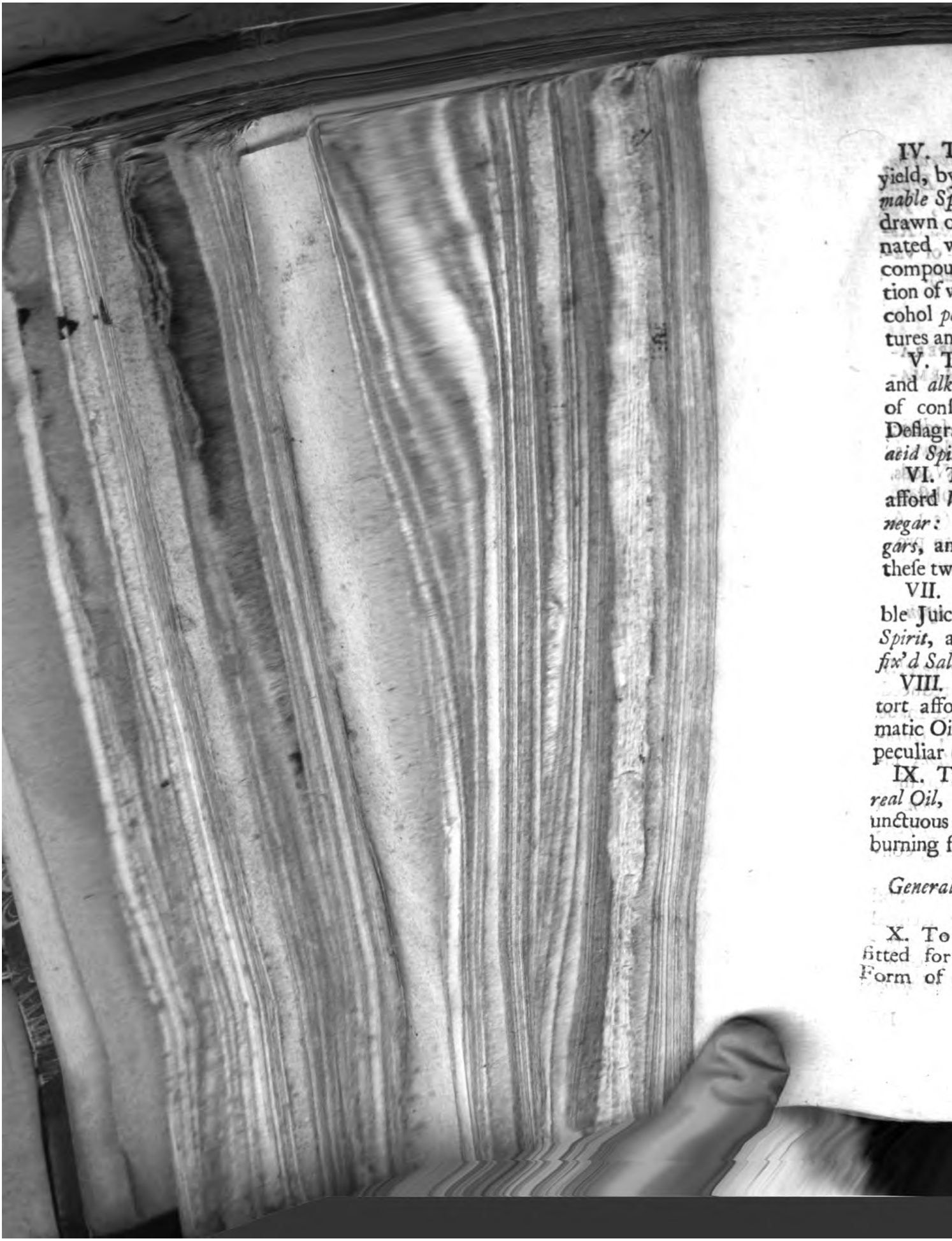
The principal SUBJECTS, *and general* OPERATIONS, to be exhibited in a *Courſe of* PHARMACEUTICAL CHEMISTRY.

I. A juſt Collection of the *Materia Medica*; or, (1.) A Set of dry'd medicinal Herbs, Flowers, Fruits, Seeds, Roots, Barks and Woods. (2.) Dry'd Parts of Animals; and animal Subſtances having any medicinal Virtue: and, (3.) A Set of medicinal Foſſils; all diſtributed into proper *Claſſes.*

General Pharmaceutical OPERATIONS *upon* VEGETABLES.

II. Experiments to ſhew how *crude, vegetable Subjects,* being barely cut, bruiſed, or reduced to Powder, may have their whole Subſtance made into *Species, Candies, Confects, Conſerves, Catapaſms, Pills,* or *Electuaries.* By *Diſtillation,* into *Waters* and *eſſential Oils*; and with a ſcorching Heat into *empyreumatic Oil.* By *Decoction* in Water or Spirit of Wine, into *Tinctures, Eſſences, Extracts.* And by *Expreſſion,* or long continued Coction, into *Oils.*

To ſhew how *eſſential, vegetable Oils* and Waters are form'd into *Elixirs,* and ſweet-ſcented *Hyſterick Balſams:* And how *expreſs'd, vegetable Oils,* boil'd with vegetable *Juices, Gums,* or *Powders,* become *Unguents, Liniments,* and *Oils,* or *Plaiſters.*



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black Coal, or pulverable Subſtance, left by vulgar, or philoſophical Calcination.

XI. That animal Subſtances, boil'd in Water, make a Jelly, Size, or Glew; and by burning *in occluſo*, afford a *Spirit*, *Oil*, *volatile Salt*, and *Caput Mortuum*, or Coal; which being burnt in the open Air, affords Aſhes and *elementary Earth*.

GENERAL PHARMACEUTICAL OPERATIONS *upon* MINERALS, *relating to Pharmacy*.

XII. Experiments to ſhew that mineral Salts are reſolvable by Diſtillation *per Retortam* into acid Spirits, and an earthy *Caput Mortuum*; and that certain ſulphureous and arſenical Minerals may be ſublimed and reduced into Sulphur, Arſenic, Regulus and Metal.

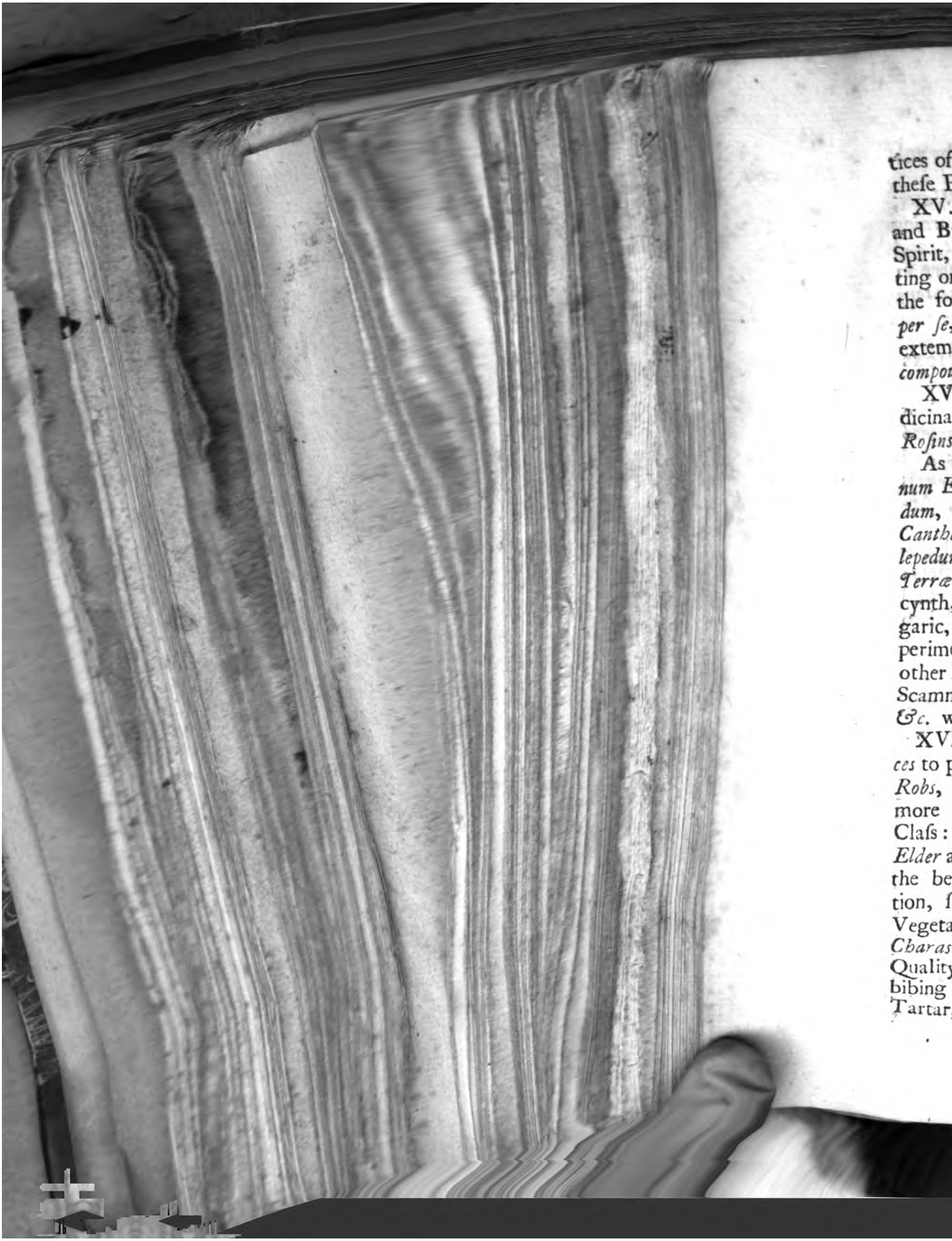
XIII. That certain *mineral Matters*, and *mineral Calces* diſſolve with Oil, and form Plaiſters; that *Metals* with *acid Spirits* form compound *Salts*; and that *Sulphur* diſſolves with Oil into *Balſams*; and with Alcohol into *Tinctures*.

III.

particular Operations, *and more neceſſary* Preparations *of* PHARMACEUTICAL CHEMISTRY.

In the VEGETABLE KINGDOM.

V. Rules for the drawing of *ſimple and compound Waters*, and *eſſential Oils*, to the greateſt perfection, exemplified by diſtilling a freſh mentha Simple in *B. M.* without any addition of water; certain *eſſential Oils*, according to the directions of Dr. *Hoffman* and *Boerhaave*; and *Compound Waters*, according to the Practice more intelligent *Diſtillers* of *London*: Uſes to be made of the *Reſiduum* in the proceſs; and the common fraudulent Practices



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XVIII. The methods of procuring the *eſſential Salts of Vegetables*, and thoſe term'd *medicated Salts*, and *fix'd Salts*; with the ways of converting the latter into Neutrals, or a Species of *medicated Salts*, by means of Tartar and *diſtill'd Vinegar*; whence the ſoluble Tartar, and that curious Salt called *Terra foliata Tartari*. Add to this, the methods of neutralizing mineral Acids, or recovering Salts from their acid Spirits, by means of fix'd, vegetable Alkali.

XIX. The beſt methods of making the *fix'd Salts of Vegetables* for pharmaceutical Uſes, and running them *per Deliquium*; particularly *Salt of Wormwood*, *Salt of Tartar*, and fix'd *Nitre*: with an Inquiry into the Reaſons of ſubſtituting *Salt of Pot-aſh* for them; and the ways of uſing theſe Salts in Infuſions and Decoctions, ſo as to extract the medicinal parts of the Ingredients, without impairing their Virtues, and deſtroying the oleaginous and reſinous Principles, or rendering them too ſaponaceous.

Add to this, the method of making *fix'd Salts* into *Cauſtics*, for Chirurgical Uſes.

X. The method of making *fix'd Salts* into MEDICINAL SOAPS; or uniting them with *Sperma Ceti*, Balſam of *Peru* and *Tolu*, of *Gilead*, Balſam *Capivi*, and other fine Ointments or Balſams: and this kind of Preparation compared with *Elæoſaccharums*.

XI. The ways of compounding *ſimple Oils*, *Gums*, *Balſams*, and certain *metalline Calces* into *Medicinal Oils*, *Unguents*, *Cerats*, and *Plaiſters*, ſpecified in the more curious and difficult Preparations of this Claſs.

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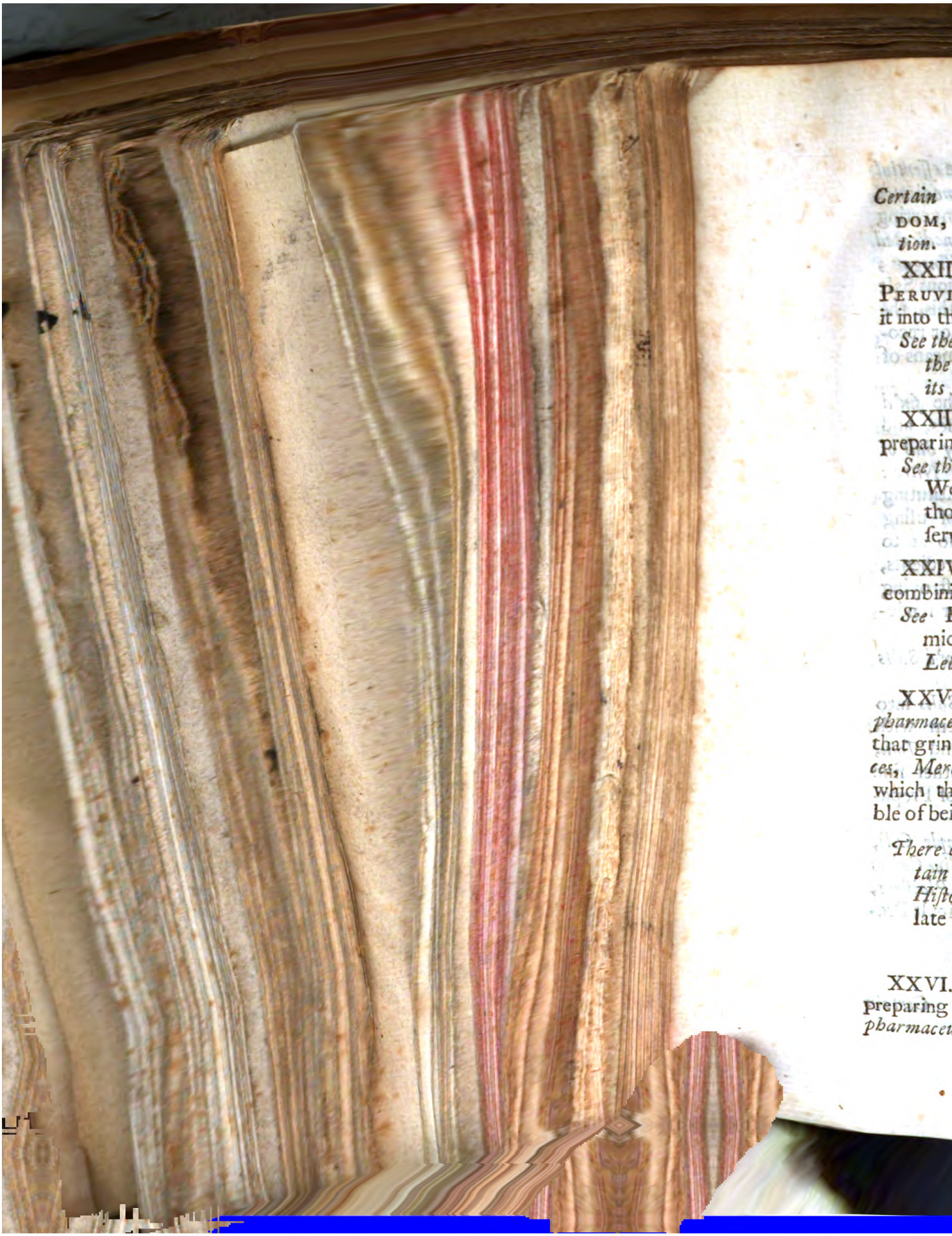

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paring of the *animal Fats*; as the *Adeps Viperarum, Axungia Porcina, Pomatum, Sevum Cervinum, Sevum Meliloti, Butyrum Maiale, Sperma Ceti, &c.* The preparing of *Millepedes, Cantharides, Cochineal-Flies, Ichthyocolla, Vipers, Rob of Urine, dry'd Blood, Musk, Civet, Sal-ammoniac, &c.*

XXVII. The method of preparing *teſtaceous animal Subſtances*; as *Oiſter-Shells, Egg-ſhells, Pearls, Crabs-Eyes, Crabs-Claws, Bezoar, Goaſtone, Gaſcoign's Powder, &c.*

XXVIII. Experiments to ſhew the effects of Decoction and Calcination in *animal Subſtances*; particularly in Hart's-horn for Jelly, and the *Decoctum album*; with the pharmaceutical Hiſtory of *animal Jellies*; and the Calces of *animal Bones.*

XXIX. The Methods of procuring the volatile *urinous Spirits, Salts,* and *Oils* of animal Subſtances; as *Hart's-horn, Blood, Urine, &c.* and rectifying or purifying them in the beſt manner, and converting the Salt into *Sal-ammoniac* for *medicinal* uſes.

XXX. The Preparations from *Raw-Silk, Vi-*rs, and ſome other curious animal Subjects.

XXXI. The various Preparations with *Sal-moniac*, particularly its volatile *Spirits, Salts,* the *Sales volatiles oleoſi*, ſimple, compound, extemporaneous; its *acid Spirit, diuretic Salt, Salt,* and *double Menſtruum*, as they are called; the general Method of ſubliming *metalline ineral* Bodies by its means.

In the MINERAL KINGDOM.

XII. Experiments to ſhew the manner of ſepaand purifying of SULPHUR by Sublimation; the method of making the *Oleum Sulphuris mpanam*, or converting almoſt the whole of the *Sulphur* into *acid Spirit*; with ſo much

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Oleum Martis per Deliquium; *Tinctura Martis Aurea*; *Tincturæ Martis cum Vino & cum Aceto*, *Flores Ammoniaci Martiales*, *&c.*

XXXIX. The pharmaceutical Preparations of LEAD; *viz. Saccharum Saturni*; the *Calx of Lead*, white *Lead*, yellow *Lead*, and red *Lead*, Balſam of *Lead*, and Plaiſter of *Lead*.

XL. The *pharmaceutical Preparations of* SILVER; *viz.* the *Cryſtals* of *Silver*, the *Silver Pill*, the *Precipitate and Tincture of Silver*, the *Lunar Cauſtic*, and the *Luna Cornea*; with their Reduction to Silver again.

The *Solution of Silver*, for turning *red* and *grey* Hair into *black* or *brown*.

XLI. The pharmaceutical Preparations of *Tin*. Calx of *Tin*; Amalgam of *Tin* with Mercury; alt of *Tin*, Magiſtery of *Tin*, Flowers of *Tin*, ublimate of *Tin*, ſmoking Oil of *Tin*, and *urum Moſaicum*, as 'tis call'd.

XLII. *The pharmaceutical Preparations of* COPR,

The Solutions of *Copper* in various ſaline, or l and alkaline *Menſtruums*, whence *Aqua Sapina*, and various Vitriols. The Preparation erdigreaſe; *the Spirit of Verdigreaſe*; the Calx Crocus of Copper; *Æs Uſtum*; and Mr. 's *Ens Veneris*.

XLIII. *The pharmaceutical Preparations of* K-SILVER.

e general Method of amalgamating Metals. olutions and Cryſtallization of Quick-ſilver, eſt ways of making corroſive Sublimate, *ius dulcis*, Calomel, red Precipitate, Precipitate, or *Turpethum minerale*, white ate, and the Oil of Mercury: With the reducing Quick-ſilver to *Æthiops Mineral*, , and a *Saccharine Powder*.

. *The pharmaceutical Preparations of* GOLD.

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and *Regulus*. The
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Poterij, *Butter* and
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XLVI. *Experim*
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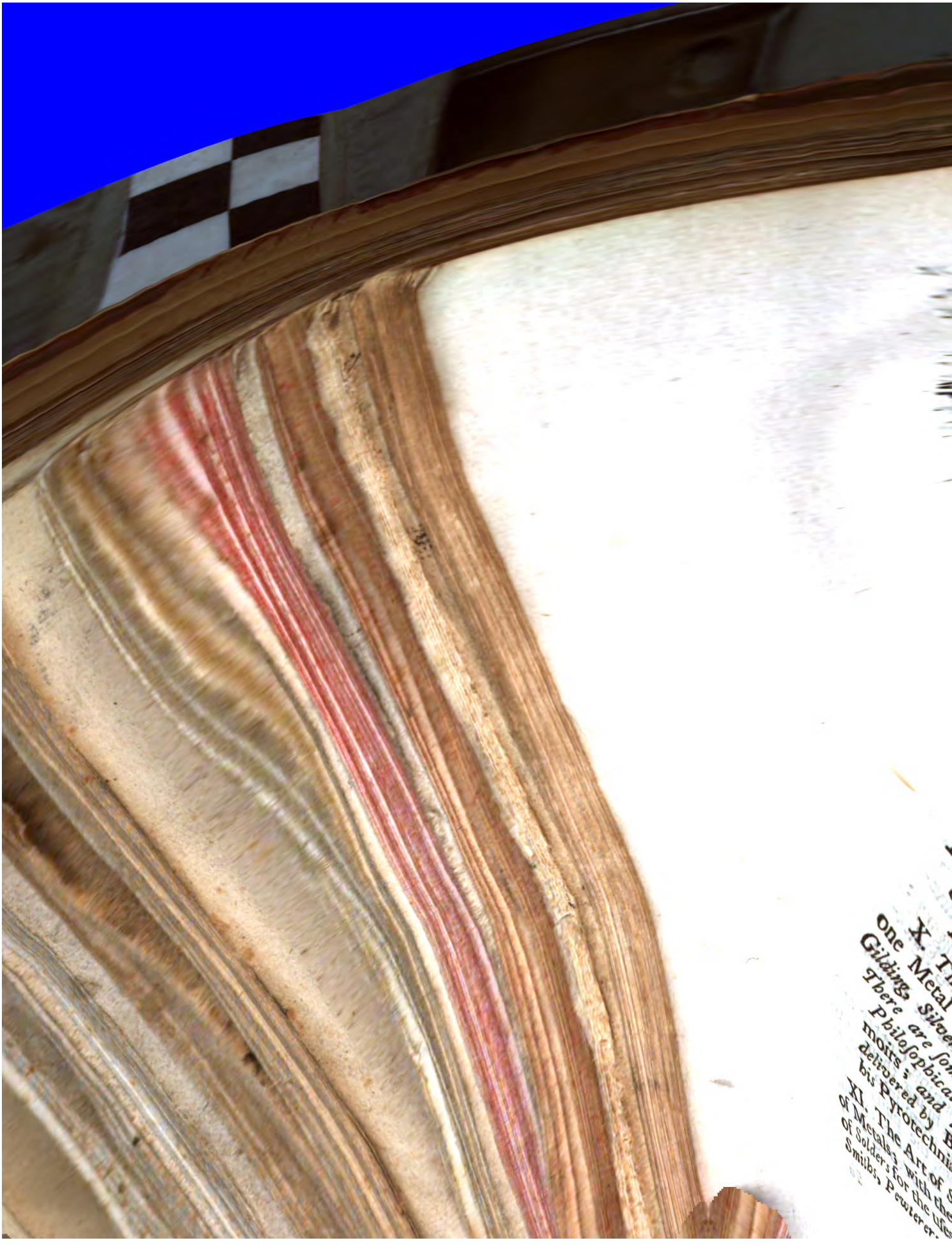
particularly Oil of
Spike, *&c.* The
Tolu, and *Gilead*;
Roſins of Jalap and
Salt of Vipers, Be
Powder and Pearl

nam, Antimonium Diaphoreticum, Cinnabar native and factitious; Quick-ſilver, *&c.*

The Authors who have treated the Subject of pharmaceutical Chemiſtry *are numerous; the generality of Chemiſts having bent their Studies this way. Among the principal to be recommended for the Service of this Courſe, ſome* Charas, Zwelfer, Dan. Ludovicus, Le Febure, Lemery, Wilſon, Staphorſt, Barchuſen, *the* Collectanea Chemica Leydenſia, *the* Pharmacopœia Collegij Regalis Medicorum Londinenſis, *and* Edenburgenſis; Boerhaave's New Method of Chemiſtry, Quincy's *Diſpenſatory, and* Hoffman's OBSERVATIONES PHYSICO-CHYMICÆ.

SCHEME



Some few Hints to this purpoſe may be found in Mr. Boyle's Philoſophical Pieces, *and* Barchuſen's Pyrotechnia.

XII. The Art of *mixing Metals* and *metalline Subſtances*, ſo as to form *compound Metals*, *Electrums*, *Braſs or Latton*, *Cannon-Metal*, *Pin-Metal*, *White-Metal*, *Bath-metal*, and all the *mix'd Metals* in uſe.

For Hints to this purpoſe ſee Houghton's *Letters*; *the* Philoſophical Tranſactions, Barchuſen, *and* Stahl.

XIII. The Art of *Wire-drawing*, or forming Metals into Wire of various ſizes for various uſes; with the different manners of Gilding it.

To this purpoſe there are ſome Hints in Mr. Boyle's Philoſophical Works, *and the* Philoſophical Tranſactions.

XIV. The *Art of Colouring* the whole Subſtance of Metals, ſo as to make *white Copper*, *white Gold*, *yellow Silver*, *&c.* with the certain ways of detecting Impoſitions of this kind.

See Boyle, Becher, Barchuſen, Boerhaave, *and* Stahl.

XV. The ways of diſſolving all Metals with proper Menſtruums, or reducing them to Vitriols and Amalgams, for particular metallurgical

Hollandus, Becher, Homberg, Stahl, *and the common Books of Chemiſtry.*

XVI. The ways of converting *Metals* into one another, particularly *Lead* and *Antimony*, for the uſes of aſſaying and teſting of Silver and Gold, and the making of powerful Fluxes for *ſtubborn*

Agricola, Ercker, Becher, Stahl, Borrichius, *and the common chemical Writers.*

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Certain Curious CHEMICAL EXPERIMENTS *relating to* NATURAL PHILOSOPHY.

I. To ſhew the chemical Nature, Generation, Production, Changes and Deſtruction of *Light*, *Fire*, *Flame* and *Fewel*, by means of the various kinds of *Phoſphorus*, and *Hoffman*'s *Phlogiſtic Liquor*; with a particular Inquiry into *Stahl*'s *Phlogiſtic*, and *Homberg*'s *Sulphureous Principle*.

See Boyle, Homberg, *and the younger* Lemery *upon the Subject of* Phoſphori; Boerhaave *and* Newton, *upon the Nature of* Light, Flame, Fire, *&c.* Homberg's *Eſſays upon the chemical Principles, and* Stahl's *ſeveral Pieces in* Metallics.

II. The chemical *Generation*, *Changes*, and *Deſtruction* of COLD and HEAT illuſtrated in a variety of *Experiments*.

To this purpoſe ſee the Experiments of the Lord Bacon; *Mr.* Boyle's Hiſtory *of* Cold *and* Heat; *and the Accounts of certain cold* Fermentations *and* Effervescences *in the* French *Memoirs, by M.* Homberg *and others*.

. The chemical Generation, Changes, and uction of *Colours* exemplified by a Set of cu- Experiments.

Boyle *on Colours*, Newton's *Optics*, *and certain apers in the* Philoſophical Tranſactions, *and* rench Memoirs.

mmon Experiments relating to ANIMAL ARTS.

Attempts to preſerve *animal* Fleſh ſweet, Salt, in long *Sea-Voyages*.

lauber, Boyle, *and thoſe who have wrote natural Hiſtory of* Sugar.

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IX. Attempts to produce from the Vegetable
gars, and Tartar, and distilling them with Brandy or
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See this Subject considered by Gmelin,
gard to Germany; and improv'd abo
Touches of Becher and Boyle

X. Attempts to imitate or exceed the TEAS of *India*, the COFFEE of the *Levant*, and the CHOCOLATE of the *Iſles*, by means of Commodities of *Engliſh Growth*.

To this purpoſe conſult certain Papers in the German Ephemerides.

Experiments relating to the METALLURGIA SUBLIMIOR.

XI. The moſt rational Methods for reducing all the *Metals* to their *running Mercuries*, or at leaſt extracting a Proportion of real Mercury from them.

See Baſil Valentine, Paracelſus, Boyle, Becher, Homberg, *and* Stahl.

XII. The Converſion of *Metals* into a *butyraceous* or *waxy Subſtance*.

See Hollandus de Salibus & Oleis Metallorum, *and* Homberg's *Paper as to a certain Matter running thro' the ſolid Body of Metals, like Water thro' a Sieve.*

XIII. Experimental Attempts for converting *mon Mercury* into real *Metal*, *Iron* into *Cop-* and *Silver* into *Gold*.

e all the intelligent and ſober Philoſophers and Chemiſts upon this head: but have a watchful eye over the Adepts; *into whoſe Nets if once Man fall, 'tis very rare that he entirely diſntangles himſelf again. Some however have caped, as Mr.* Boyle *and Dr.* Stahl, *without ejudice to their Philoſophy and good Senſe; t* Kunckel, *and even* Becher, *notwithnding all his Learning and Experience, came a little tinged with their Myſtery and Jar-. And if we might venture to play the aſters, in a Subject where it were fitter for to learn than to teach, we would here give*

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gredient, being certainly known and demonstrable
and the manner and reason of the whole Ope-
tion clearly comprehended & after here as
more to be endeavoured & after here as
ceſs is of great Concern, any considered
Senſes would hazard any considered
his Fortune in a Proceſs superfluous
other Notion than of a Riddle.

has a happy Talent of unriddling theſe dark Proceſſes of the Adept, *and can find a Clue to guide himſelf by; let him firſt be ſure that his Head is ſound, and his Hand experienced; and good Succeſs attend him: But for a Man to enter upon a* Courſe of the ſublimer Metallurgy, *in hopes of raiſing a Fortune; without being well acquainted with common Chemiſtry, and common Philoſophy; would be juſt as wiſe as to attempt the* Longitude *at Sea, to a* Degree, *without having ever ſeen a Ship, or receiv'd any Tincture of* Navigation, Mechanics, Geography, *or* Aſtronomy.

Uncommon Experiments relating to MINERAL ARTS.

XIV. Attempts to prepare *Varniſhes* and *Porcellane-Ware*, exceeding thoſe of *China* or *Japan*.

See certain Papers in the Philoſophical Tranſactions, French Memoirs, *and* German Ephemerides.

XV. Attempts to imitate *Tutenag*, the white red *Copper* of *Japan*, and the fineſt *Bar-Copper Germany*.

ee Dr. Woodward, Stahl, Homberg, *and the profeſs'd Metallurgiſts.*

VI. The moſt promiſing Methods of making *able Iron* with Pit-Coal, in the large way.

, above all others, Dr. Stahl *in his ſeveral curious Pieces upon* Iron.

II. Attempts to make *Regulus of Antimony ble*.

Becher *and* Stahl *upon the Lead of* Antimony, *and compare them with* Boerhaave's *Doctrine as to the Reduction of* Antimony *to* Silver.

See Neri, Kunckel, Blancour, *the Author of* Sol ſine Veſte, Becher, *and* Stahl.

XXIV. Attempts for converting all the *Metals* into their ſpecific GLASSES, without Addition.

See M. Homberg's *chemical Experiments with the great burning* Lens; *and compare them with the Operations of* Neri *and* Kunckel *at a Glaſs-Houſe Fire.*

XXV. Attempts for ſoftening GLASS, or bringing it towards a malleable State: and again, for giving it nearly the Hardneſs of a *Diamond.*

See Boyle *and* Homberg *upon this curious Subject*; *and compare them with* Neri, Merret, Blancour *and* Kunckel.

We might next proceed to ſketch out *Schemes* for *Courſes* of *Recreative Chemiſtry*; ſhewing the artificial Generation of Clouds and Meteors in a *Room*; new Ways of illuminating at *publick Entertainments*; *artificial Fire-works*, and numerous other delightful and ſurprizing Productions and Phænomena of this Art, in the way of *experimental Philoſophy*; or what was antiently term'd *natural Magic*: But 'tis time to deſiſt, leſt inſtead of gratifying, we ſhould ſatiate the Curioſity of our Readers with too full a View of the immenſe and dazzling Treaſures of UNIVERSAL CHEMISTRY.

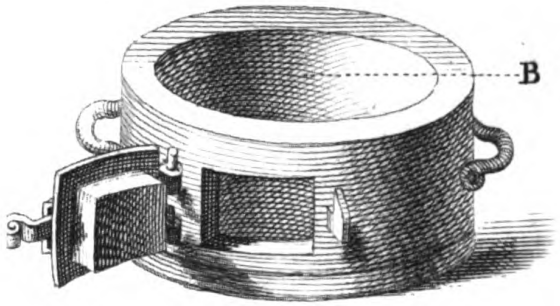
The E N D.

ERRATA.

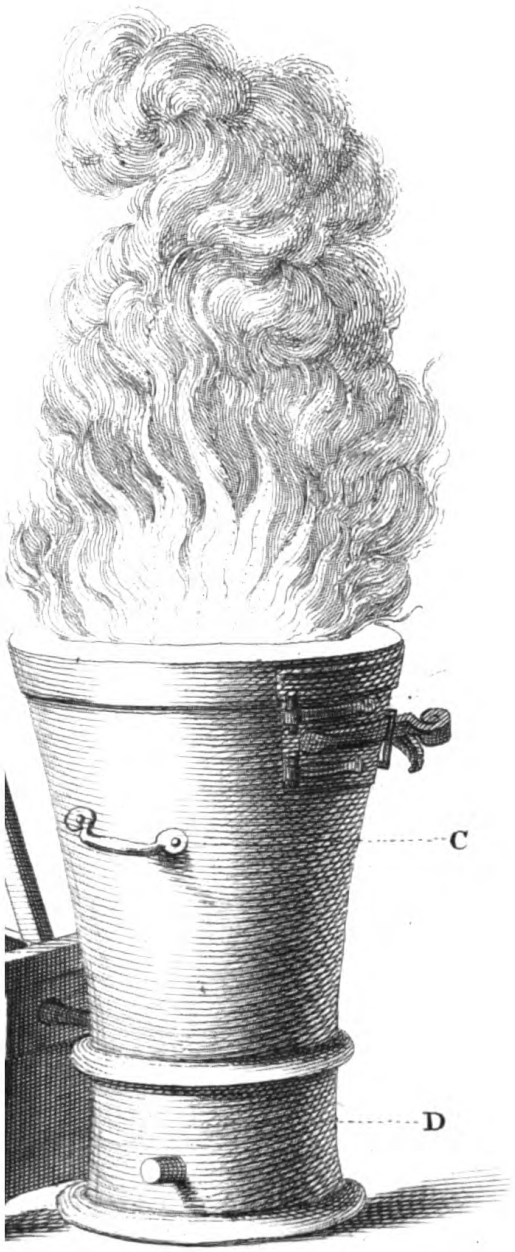
Pag. 5. Lin. 18. read *Competitor.*
Pag. 27. Lin. 6. for SE RATION read SEPARATION.
Pag. 28. Lin. penult. read *Apothecaries.*

Plate 1.

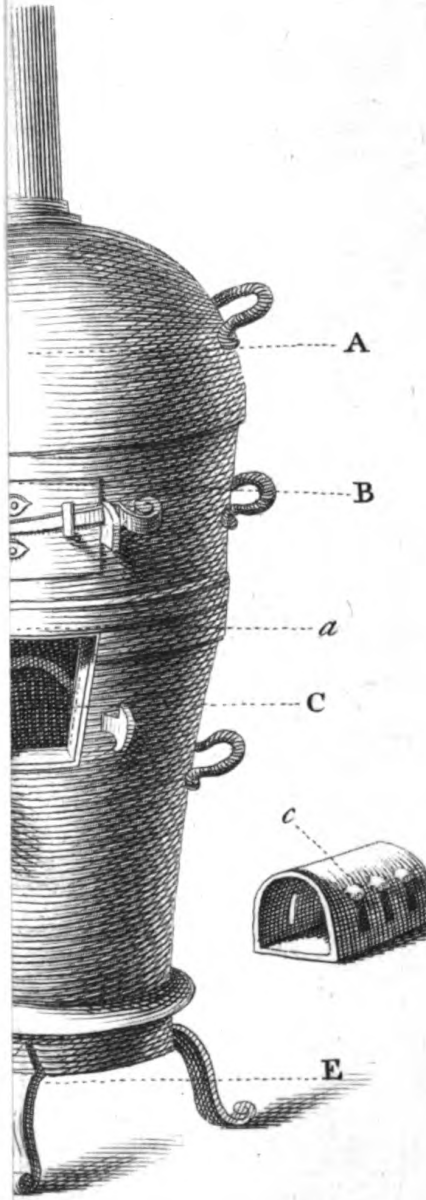
II.

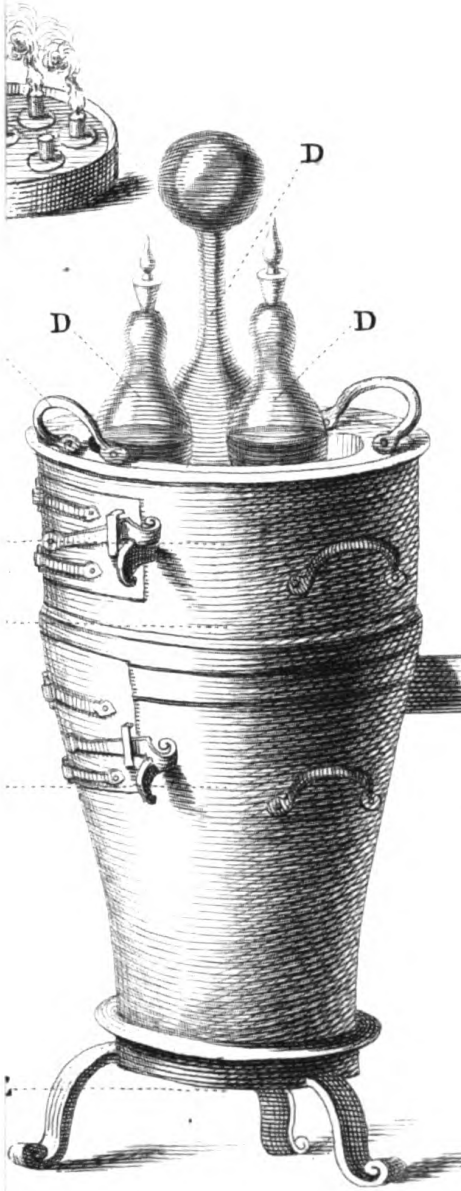


III.



te IV.

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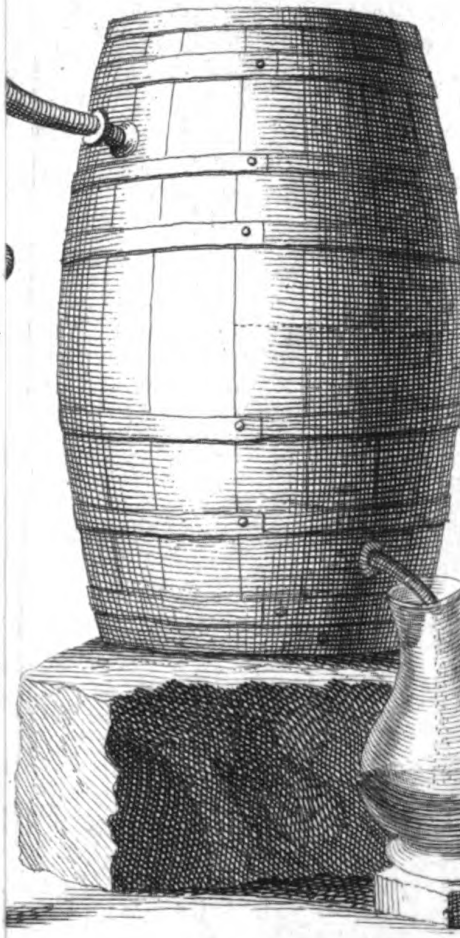

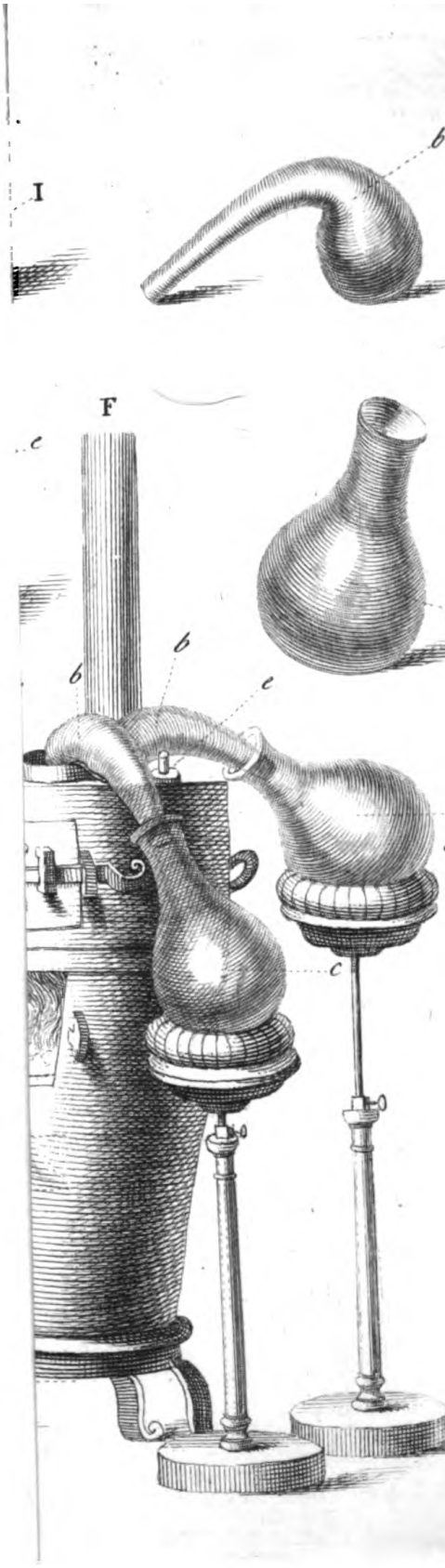
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VIII.