

New experiments, and observations, made up on icy noctiluca ... To which is annexed a chymical paradox [grounded upon new experiments, making it probable, that chymical principles are transmutable] / [Robert Boyle].

Contributors

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ROBERT BOYLE'S
ICY NOCTILUGA
AND
CHYMICAL PARADOX.

168¹/₂



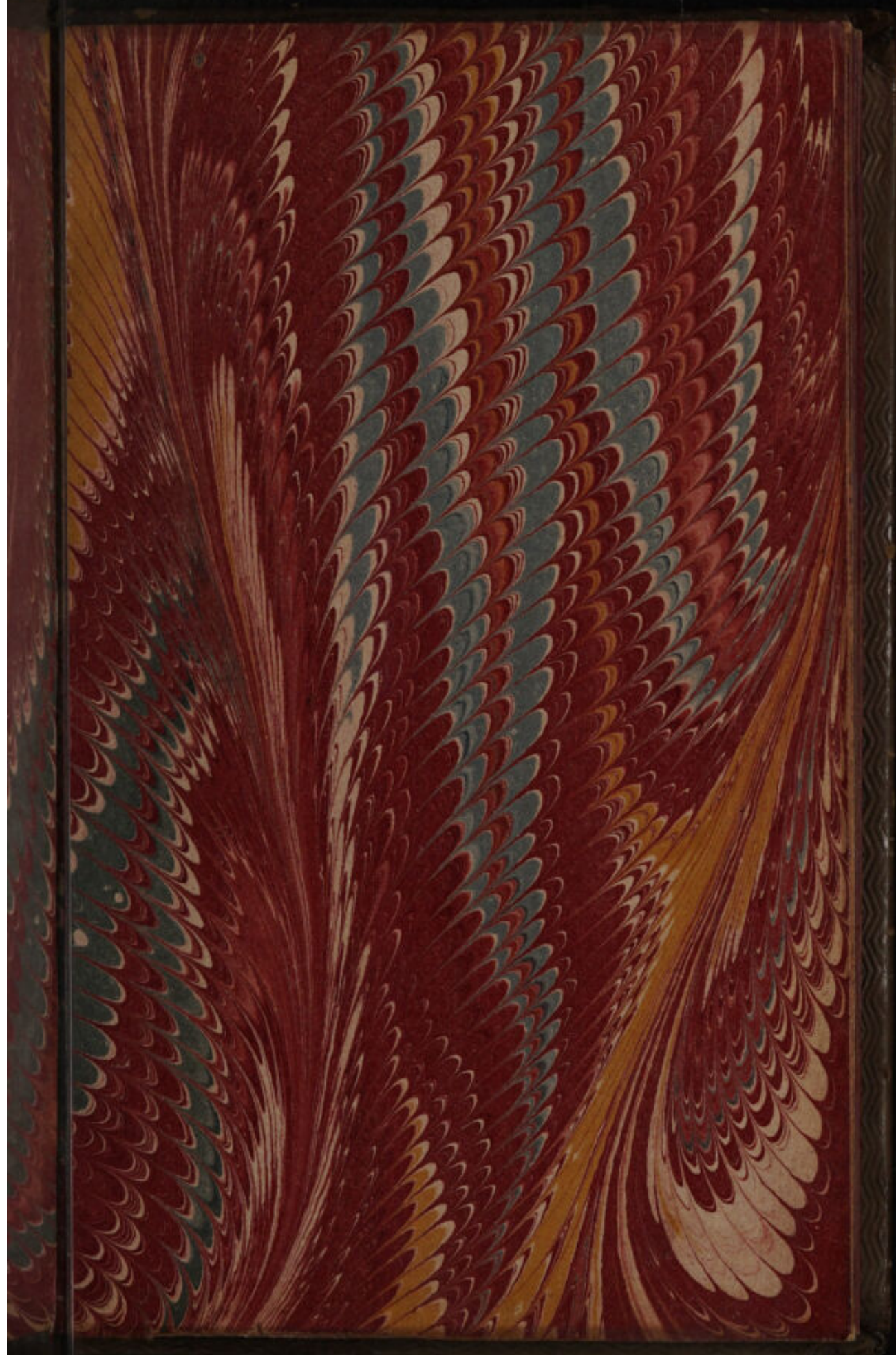












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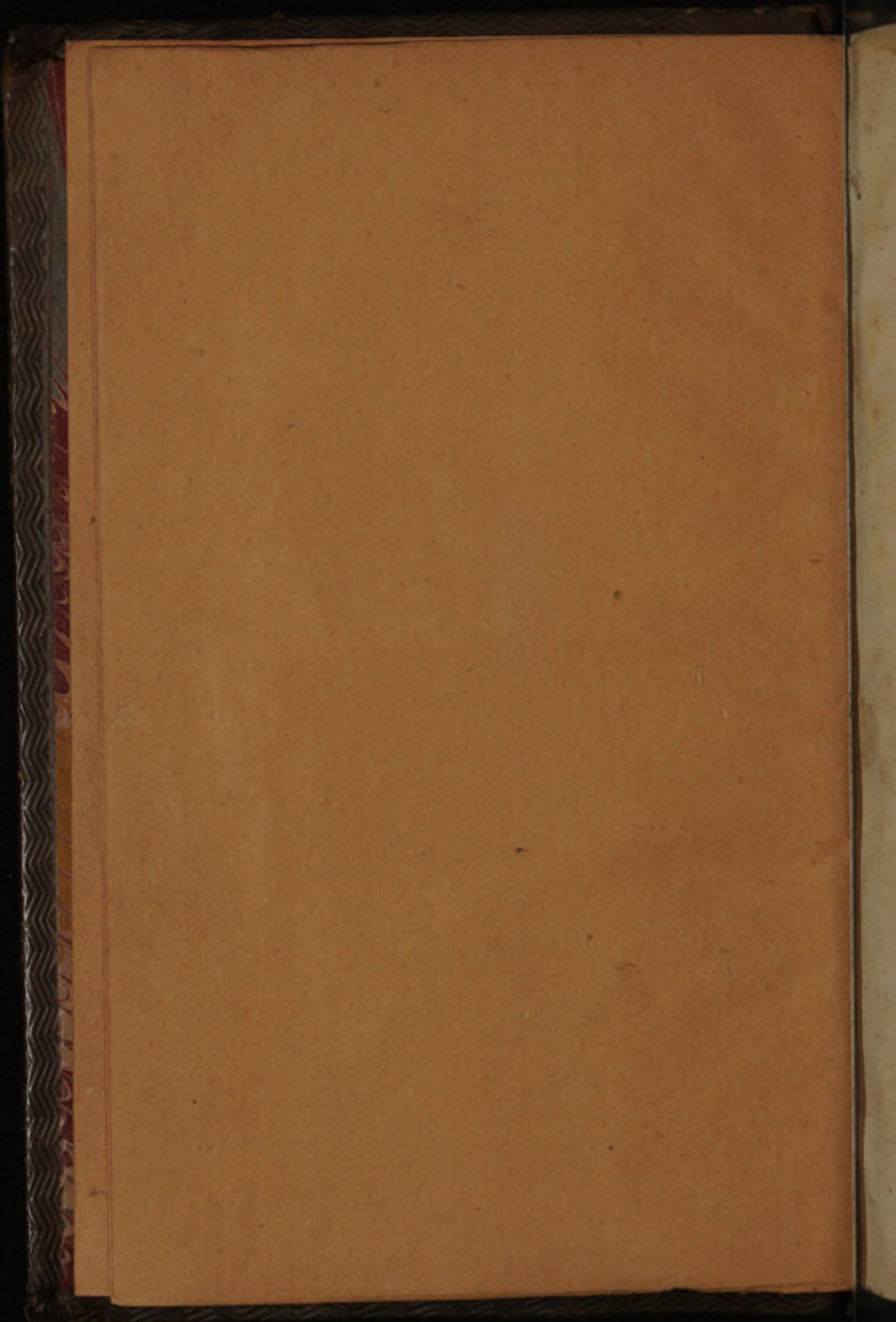
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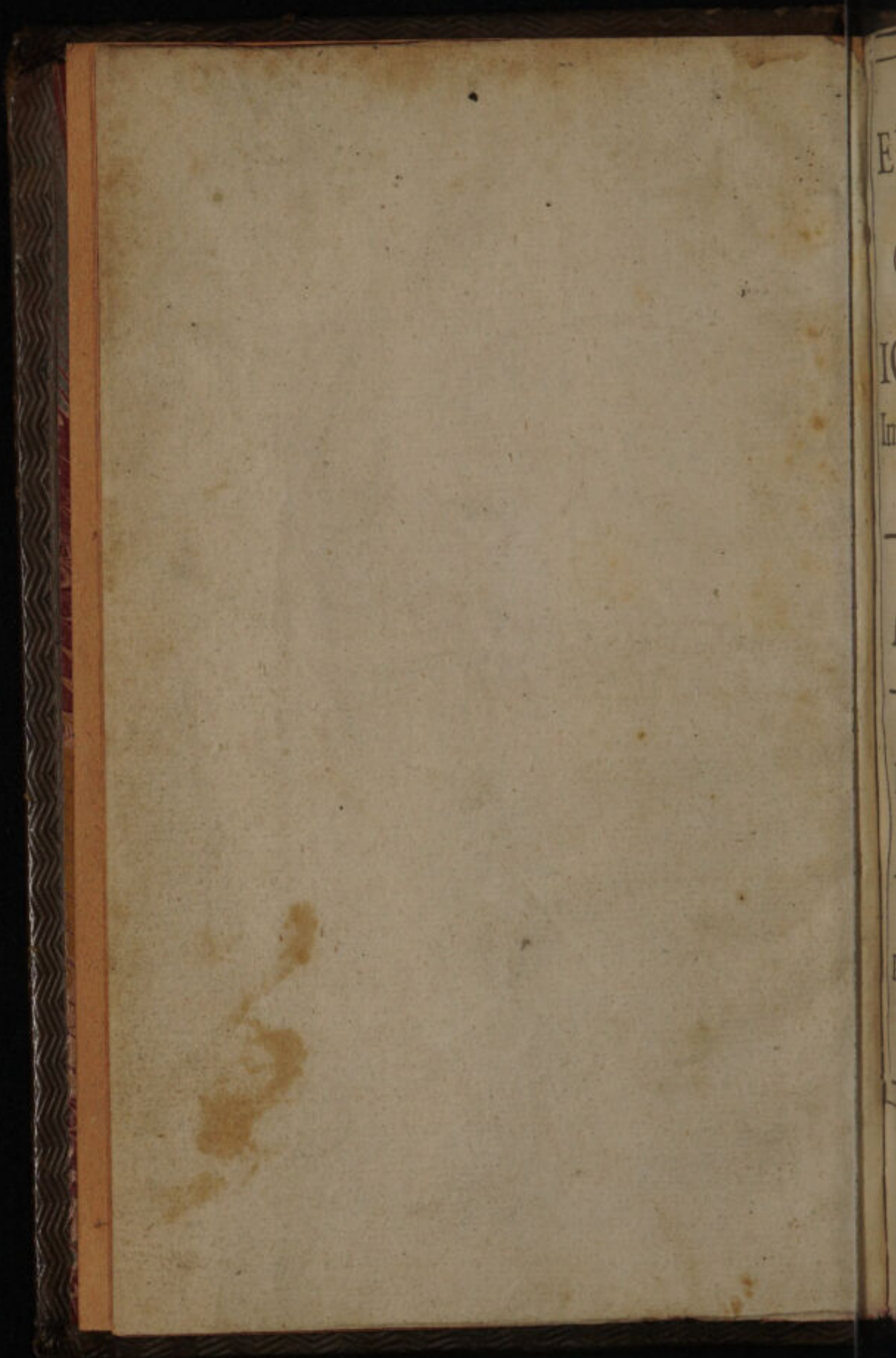
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History

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NEW
EXPERIMENTS,
AND
OBSERVATIONS,
Made upon the
ICY NOCTILUCA.

Imparted in a Letter to a Friend
living in the Country.

To which is annexed
A Chymical Paradox.

By the Honourable
ROBERT BOYLE,
Fellow of the *Royal Society*.

LONDON,
Printed by R. E. for B. Tooke, at the
Ship in St. Paul's Church-yard.
168 $\frac{1}{2}$.

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A N
ADVERTISEMENT
OF THE
PUBLISHER
TO THE
READER.

THose, who have published some former Tracts of this Honourable Author's, have made their Complaints, That his Writings have not met with the same Candor and Ingenuity from all Writers: For
A 3 though

Advertisement.

though *some* have very civilly mentioned his Name in those Experiments, Observations, and *Phænomena*, which they have borrowed from His Writings; yet *others* have vendicated that to themselves, which was none of their own; for having lighted their Candle at his Torch, and raised some Superstructures upon those Foundations he had laid, they have made no mention of him at all; in which matter the Sincerity of Philosophers is not a little required.

'Tis known, That Mr. Boyle was the First Inventer of that *Pneumatick* Engine, or *Air-Pump*, called from Him, *Machina Boiliana*; the Figure and many of the uses whercof he hath described in his

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his *Traët* entituled, *New Physico-Mechanical Experiments concerning the Spring and Weight of the Air*, (and in the *Continuation* of it;) which Book, being Translated into *Latin*, and dispersed into Forreign Parts, hath given occasion to Transmarine *Virtuosi* to make Essays (not altogether unsuccessful) concerning the Fabricating of the like Engines; though none of their *Traëts* upon that Subject have equall'd the Original. In like manner 'tis highly probable that his *Dissertations* concerning *Phosphorus's*, and his free Distribution of several Parcels of that *Luminous Substance*; have excited others to descant upon the same Subject.

But that it may justly ap-

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pear, That the Honourable Author shines only by his own Light, and hath not any thing mutuatitious in the following *Treatise*, the Reader is to be advertised, That this Tract had much earlier come abroad, if, after I had received the *Whole*, even to the last Sheet in 1681. that for the *English* Edition, and my *Latin* Version thereof (where-with the Noble Author was willing to gratifie the *Curious* in Forreign Parts) might be carried on together, I had not been by long Sickness, and divers unfavourable and unexpected Circumstances, obliged to retain it some Months in my Hands.

Which I am the more troubled at, because I find, that my
necessi-

Advertisement.

necessitated Delay hath given Opportunity to the Publication of some Experiments about *Noctiluca's*. But the *Virtuosi*, who have the Honour to be acquainted with the Noble Author of this Book, and have seen the last *Summer* and *Autumn* divers of the Chief Experiments made, which are mentioned therein, will easily believe, that the Author needed not to borrow any thing from those *Specimens* which have been lately published by an ingenious Man about *Noctiluca's*; which, beside that they contain but very few *Phænomena*, or *Trials* coincident with *His*, were so far from affording him any Information, that (to be sure,

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sure to be no Borrower) he never would to this day read any one of them, or hear them read. And it appears, by the Close of the *Aerial Noctiluca*, presented in Print to the *Royal Society*, towards the end of the Year 1680. that he then knew and had practised several other Ways of making *Noctiluca's*, than *That*, which he *Then*, and before any other Man, imparted to the World.

The Usefulness of the ensuing Discoveries and Reflexions will be best judg'd of by discerning Readers, who therefore need not to be previously informed thereof by me.

PRE-

THE
PREFACE.

S I R,

T*He very kind Reception, you were pleased to give those Papers about the AERIAL NOCTILUCA, that I address'd to you about the beginning of the last Winter, does not only invite me, but in a manner oblige me to impart to you some Trials, that I made, after I had sent you the others, about the same kind of Phosphorus; to which you may now be pleas'd to annex them, by way of Continuation, or Appendix. But that being true, which is noted*
by

Preface.

by Lucretius, where he prettily says, *That-----Res accendunt lumina rebus*, you will not think it strange, that if this Observation holds in other things, it should particularly take place in Luminous things themselves: and therefore, without any further Preamble, I shall tell you, That whilst my Occasions permitted me to stay in London, I was willing to try, whether I could carry on somewhat further that which had already been not unsuccessfully begun. And accordingly I caus'd to be prepar'd and distill'd four or five several Materials, which I thought the Curious, especially those addicted to Chymistry, would wish to have had Trials made upon, and would perhaps blame me,

Preface.

me, if I had omitted to employ. But those Materials, not answering what was desired, we made choice of another or two, which I forbear to name, for certain Reasons, and particularly for this, because they are to be found but in very few Places, and perhaps would not have serv'd my turn, if I had not luckily procur'd them in a Season whose Dryness continued almost to a Wonder.

From these Materials sometimes, and sometimes also from the dry'd Residence of Urine, we obtain'd now and then some of the Aerial Noctiluca, such as That you have hitherto receiv'd Accounts of; but more frequently a Nobler sort of Phosphorus, about which I now proceed to impart to
you

Preface.

you some Observations, as I did, without any curious Method or Ornament, set them down from time to time as I hapned to make or remember them. And, to facilitate the Pardon I beg of you, for having omitted some Experiments that perhaps you will wish I had made, I must acquaint you, That being by some Necessary Occasions enforced to leave London, for a much longer time than I have done for several Years last past, I have been oblig'd to make most of the following Trials in a small Village, where I yet am, and where, being unaccommodated with Furnaces, Instruments, and other Chymical and Mechanical Conveniences, for making and varying Experiments, you receive an Account

Preface.

count not of all the Trials, I would have made, (some of the Chief of my Catalogue remaining still unattempted) but of all Those I could make in my present Circumstances. However, such as they are, I think not fit to delay any longer the acquainting you with them; and therefore have order'd them to be gather'd into one small Collection of Memoirs, to which Paper I have given the Title of The Glacial or Icy Noctiluca, not only to distinguish it from the Aerial one, whereof you have already had an Account; but for another Reason, that you will quickly meet with in the little Tract it self, from whose Perusal I must not now any longer detain you.

Preface.

I count not of all the Trials I would
have made, (some of the chief of
my Catalogue remaining still un-
attempted) but of all those I could
make in my present Circumstances.
However, such as they are, I think
not fit to delay any longer the ac-
quainting you with them; and
therefore have ordered them to be
gathered into one small Collection
of Tracts, to which I have I
have given the Title of The Cla-
ssical or icy Novellus; not only
to distinguish it from the Annual
one, whereof you have already had
an Account; but for another Rea-
son, that you will easily meet
with in the title Tract it self.
From whose Tracts I want not now
any longer detain you.

An
APPENDIX
 To the
AERIAL NOCTILUCA.

SECT. I.

THE shining Matter, contain'd in our best Phials, being partly wasted in Experiments, and partly given away, I thought fit to try, whether by the help of Heat and other Motion, our want might not be somewhat supplied, till more *Noctilucous* Matter could be prepared.

B *Experiment*

Experiment I.

In pursuit of this Design, I took an old Phial that had been long laid aside as useless, because the Matter had been poured out of it into a clearer and smaller Glass, and having held that side of this Phial, to which I perceived some Feculent Matter stuck, near the Fire, till it had conceived a considerable degree of warmth, I remov'd it into a dark place, and as I expected, found it to shine, and that Vividly enough, whilst it retain'd a Competent degree of heat; and when it cooled too much, the Light ceased with the Agitation, that as a Cause or a Condition accompanied it. But if afterwards the Phial were again held to the Fire as before, the shining Power would be excited, and the Splendor would continue a pretty while. But after some days or weeks (for I remember not which,) this Disposition to be made Luminous by external heat, was utterly lost. *Experi-*

Experiment II.

Having also taken notice of a little Feculent Stuff, that stuck to the inside of the Glass, that had contain'd some of our *Noctilucal* Matter, I imagined, that though it would not shine in the dark by the contact of the Air, to which it had been too long accustomed; yet when once that dispirited or disanimated Superficies, (if I may so call it,) that had lain exposed to the Air, was removed, the more Internal part of the Matter might not be destitute of a shining Power. I carefully scraped off, the outermost Surface, and rubbing a little of the rest with my finger upon my hand, I found it to shine well enough. And though the Matter, being once more left exposed to the Air, did lose in its Superficial parts the Virtue of shining in the dark; yet those parts being taken off, the remaining Matter (being rubb'd) did not appear destitute of a Luminous

Quality, so that it seemed, that though the Air did after a while, mortifie as it were and spoil the Superficial parts that were exposed to its immediate Contact, yet this vitiated Surface served for a kind of Cover or Fence to the Matter that lay beneath it, and kept it from Evaporating or Spending those Spirituous or Subtile parts, on whose Account it was capable of becoming Luminous.

Experiment III.

And as I had observed on other occasions, that Liquors abounding in Tenacious parts, though the Liquors did not appear opacous or Feculent, would leave sticking to the insides of the Glasses, that contained them, somewhat, that though generally not perceived, because not very manifest, was by some other ways that I had tried discoverable: Having, as I was saying, observ'd this, in some other Cases, I suspected, that even in a Phial that had formerly contained

contained some of our shining Substance, though it seemed to have been well emptied, and to have no gross Feculency adhering to it, there might stick somewhat, which though unobserved by the naked Eye, might be made visible to the naked Eye, by heat or motion. In pursuance of this Conjecture, I took this Glass, and having crackt it into Fragments, that it might be put into the neck of a Phial of a convenient shape and size; and having well stoppt the Vessel and removed it into a dark place, we there shook it, and had the pleasure to see, not only that Light was readily produced by the motion excited in the jostling of the parts one against another, but that by reason of the various position of the Fragments of Glass, some looking upwards, some downwards, some to the right hand, and some to the left, the light seemed to be Vibrated every way, with a very delightful Vividness. This Production of a kind of blazing Light was often repeated with these bro-

ken pieces of Glass, and if the Phial were heated, the effect seemed more quick and considerable: And (if I misremember not,) by only warming the Phial, without shaking it, a Light would be produced.

Experiment IV.

Afterwards having beaten some of the Glass into such small pieces as were capable of passing through the neck of a Glass-Egg with a flat bottom, that it might stand upright of it self, we Hermetically sealed up the neck, to try whether by this hindring the included Matter from exhaling or transpiring, we could keep the beaten Glass always fit to exhibit the *Phænomenon*; but we found not the event answer our desires, for after no long time, we could no more produce any Light in our Sealed Vessel, though an unlucky Accident happening in one of our last Tryals, keeps me from being fully satisfied of the unpracticableness of the thing designed.

Experi-

Experiment V.

In the Printed Tract of the *Aerial Noctiluca*, there is mention made of some Liquor that was *Hermetically Sealed* up in a bolt-Glass, that was not great, to try whether by this way we could for any long time preserve the shining faculty of that Liquor wherein it was already exceeding faint, and not to be excited but by a considerable degree of heat, and a vehement agitation of the Vessel it self. This Sealed Glass having been left in the corner of a Window, for what was judg'd a competent time, we yesternight approached the Vessel by degrees to the Fire, and shaking it from time to time till the included Liquor had acquired a considerable degree of heat. Then removing it to a dark place, and shaking the Vessel somewhat strongly, we perceived that the disposition the Liquor had to shine, was very much impaired, but not quite abolished.

abolished. For there would from time to time, upon the rude agitation it was put into, appear little portions of Matter that looked prettily, and shone very Vividly, like sparks of Fire; and some of these appeared in the *Spherical* part of the Glass, and some in the Neck. Some of them seemed as it were fixed to their first Station, and others moved upwards and downwards, and most of them continued some time to shine a pretty while before they disappeared, and when they vanished, few of them did so by degrees, but each luminous speck, when it had lasted out its time, lost its whole Light at once.

SECT. II.

THE new Liquid *Phosphorus*, I lately mentioned to have been made, since the publishing of the *Aerial Noctiluca*, was poured into a large Phial, that might contain (by our guess) ten or twelve times as much

much as was put into it, so that the shining Matter, having so much Air included with it, might thereby be assisted to diversifie at least some of the *Phenomena* afforded by former *Noctilucas*.

Observation I.

And accordingly I observed in the first place, that though the shining steams filled the whole cavity of the large Glass, that was untaken up by the Liquor and the residue, and this lighter flame continued much longer at once, than any we have hitherto mentioned, for it continued Vivid several Days and Nights together, without ever unstopping the Phial to give it fresh Air. And, if I misremember not, I observ'd it to do so for about a week, before my occasions hindred me from observing it any longer.

Observation

Observation II.

I sometimes took notice with pleasure, that some Exhalations or Vapours, that appeared considerably luminous, seemed to roll to and fro, like little Clouds or Aggregates of Smoak in the Cavity of the Vessel, though it seemed difficult to determine what should give them, and maintain in them, such a motion.

Observation III.

The bigness of the Glass being considerable, it happened that sometimes when I went into the darkned place where I kept it, so much luminous Matter would make a surprising shew, but though its extent were far greater, yet its intensity did not much exceed that of the Light afforded by the *Noctilucas* of the first sort, as for distinctions sake, those may be called that are mentioned in the Printed Account. Only this I often
took

took notice of, that, in case I shook the Matter gently, the Light would appear much more vivid, and, as it were, would flash in and about the surface of the Liquor where it was Contiguous to the Air, than it did elsewhere. And this splendor was such, that if it had been lasting, I thought it would have made our *Phosphorus* useful for considerable purposes.

Observation IV.

When after having so many Days kept this Glass stopt, at last it would not longer shine of it self, we supposed it to be reduced to the condition of a *Phosphorus* of the first sort, and accordingly found, that upon the removal of the Stoppel, and ingress of fresh Air, the Cavity would in a moment be filled with fumes that lookt white in an enlightned place, but luminous in a dark one, and (probably by reason of the quantity of the Air contain'd in so capacious

cious a Glas) the light usually continued much longer than 'twas wont to do in *Noctilucas* of the first sort.

Observation V.

Being desirous to try, whether this more vigorous Matter, if it were kept so exactly stopped, that none of the Luminous Vapours could exhale, would not last very long, I put near two spoonfuls of the Liquor with some of the sediment into a bolt-Glas (with a flat bottom that it might stand without leaning) capable of containing in all near twice as much, this Glas being Hermetically Sealed, the included Liquor continu'd to shine without any external help either of Air or Heat, for about six Days and Nights, but then it gave over shining, nor would be made luminous again by moderate shaking.

Observation

Observation VI.

After having poured out some more of the Liquor and Sediment that had been kept in the great Phial, formerly mentioned, into a smaller Phial, to make a Present of it to a *Virtuoso*, the remaining Matter, having now a greater proportion of Air included with it, was very apt to be put into a Luminous agitation, if I may so call it, and would emit Exhalations, that would not only fill the Cavity of the Glass, but manifestly move to and fro in it after a somewhat odd manner. And being one Night willing to give a Lady, and some other Company, the divertisement of a new *Phenomenon*, after having opened the Phial, and then having stopt it again, I shook it, and turned it in such a way, that much the greatest part of Liquor having been before poured out, the residue was as it were spread over the inside of the Glass, to which its Particles

ticles stuck, because there wanted Liquor enough to wash them down: By which means, those little portions of the Sediment being not covered, as they were wont to be with Water, but exposed to the immediate Contact of the Air, shone much more vividly than the Luminous Exhalations were wont to do, and the light being tremulous and twinkling, as well as brisk, they seemed to emulate so many little Stars in a Cloudless but dark Night, and continued this Scintillation longer than one would have expected, to the no small delight of the beholders, for whose sake the Experiment was several times repeated with success.

NEW

NEW PHÆNOMENA

Exhibited by an

ICY NOCTILUCA,

OR,

Solid Self-shining Substance.

SECT. III.

IN the Address of the foregoing Appendix to the *Aerial Noctiluca*, I intimated the Reason, why I did not think fit to give you a more particular account of the Materials I employ'd in prosecuting my design, of making better qualified *Noctilucas*. And therefore I shall not for the present trouble you with the mention

mention of proceedings, that for want of some things seldom procurable, you would not where you live, be able to imitate: But shall save you and my self the trouble of a further preamble.

Having then by processes, not unlike that I annexed to the *Closé* of the *Aerial Noctiluca*, obtain'd a Self-shining Substance of a *Consistent form*; I proceed to give you some account of what I have observed about it, and try'd with it, which will take up the less time to do, because many things belonging to it in common with the shining Liquor, with which I have already entertain'd you, those will be the fewer that belong peculiarly to the Self-shining Matter, endow'd with a *Consistent form*.

About which it may be proper to take notice of some affections, that seem more immediately to belong to the Substance it self, than most of the things do that are to follow.

Some

*Some Qualities of the Noctiluca it
self.*

1. And first, Though it usually came over in distillation in the form of divers little Grains, or Fragments, differing for the most part from one another, both in bigness (some being of the size of Grains of Corn, and others of Pease, or large Cherry-Stones) and also as to their shapes, which most commonly were irregular, as Concretions are wont to be, that are casually produced, yet when the Distillation was carried on prosperously, we obtain'd the desired Matter in greater Lumps; sometimes as large as small Beans, and sometimes at least three or four times as large, but not proportionably thick.

2. These Lumps whether small or great, were Colourless; and usually when they were held against the Light, transparent; so that divers Bodies placed beyond them at a convenient distance, might be plainly
C seen

seen through them. And some of the bigger appeared so like such Fragments of *Ice*, as being thin, are oftentimes very clear, and almost quite destitute of manifest Bubbles; that because of this great resemblance, and for distinction sake, I thought it not amiss to call our consistent Self-shining Substance, the *Icy* or *Glacial Noctiluca* (and for variety *Phosphorus*) which name I chose to give it, rather than that of *Crystalline*, because this Epithet is not unfrequently given to every *Diaphanous* Liquor, as well as to *Transparent* Solids. But when I said, that our *Noctiluca* was *Transparent* and *Colourless*, I meant it only in reference to what usually appeared. For whether it were any real difference in the Texture or constitution of the Body it self, or the effect of some casual junctures of Circumstances, I am not sure; but this occur'd to us, that sometime, especially by Candle-Light, some lesser Fragments appeared not *Diaphanous*, nor always either *Colourless*, nor of the same

same Colour. For sometimes the Matter looked Reddish, sometimes of a faint, but pleasing Blew, and sometimes too, of a Colour to which I cannot easily assign a known Name.

3. Our *Icy Noctiluca* or *Phosphorus*, is manifestly heavier in *Specie* than common Water, in which being put, it readily sinks to the bottom, and quietly lies there.

4 The Ice-like Body, though consistent, is not hard; being far less so, than common *Ice*; but yet 'tis not so soft but that 'tis brittle, and will more easily be broken in pieces by the pressure of ones Fingers, than receive shapes from them; and yet by him that goes somewhat warily to work, it may be spread upon a solid Body, almost like the unmelted Tallow of a Candle.

5. The Consistent *Phosphorus* is fusible enough. For though in the Air it will not be brought to melt, without some difficulty and waste, yet by the help of hot Liquors, and even of Water it self, it may with a

little care and dexterity be brought to melt, which is an Observation of good use; because by means of fusion, several Fragments (if the Matter be pure enough) may be brought to run into one Lump, and in that condition may both be the better preserved, and become fit to be applied to some considerable uses, which cannot so well, if at all, be made of lesser, though numerous Fragments.

6. This *Glacial Noctiluca* is, as to sense, cold, but of a texture that disposes it to be easily agitated, and by agitation become incandescent, as will appear hereafter. When this Solid *Noctiluca* is held in the free Air, though perhaps its superficies be wet, it affords a very vivid Light, usually surpassing That of the *Aerial Noctiluca*, and this Light seems to proceed from, if not also to reside in the Body it self.

7. When our *Icy Phosphorus* is taken out of its receptacle, and exposed to the immediate contact of the free Air, it usually emits a wonderful
deal

deal of Smoak, discernable by the Light of the Body it ascends from; and this plentiful emission of Effluvia usually lasts as long as the *Phosphorus* is kept in the Air.

8. But 'tis pleasant to observe, and deserves to be considered, That as soon as 'tis plung'd in Water, so as to be quite covered with that Liquor, it ceases not only to Smoak as before, but to shine, as if a thorowly kindled Coal were suddenly quenched in Water. And if it were not for this, our *Noctiluca* would effluvia so fast, that it would be quickly wasted; whereas the Water, fencing it from the contact of the Air, keeps it from spending it self as formerly, and yet does really make but a seeming and temporary extinction of this *Anomalous* Fire. For as soon as 'tis again taken out of the Water (though it have lain there perhaps a great while) it falls to shine again, even whilst 'tis yet dropping wet.

9. And I have sometimes had the pleasure to observe, that when I had

so large a Piece of *Noctiluca*, that I could conveniently hold one half of it under the Surface of the Water, and the other half above it, whilst the emers'd part afforded no Light, the extant part shone Vividly.

Having thus mentioned most of the qualities that belong to the *Noctiluca* it self, I shall now proceed to the *Phenomena*, my Tryals on it, or with it afforded me, without confining my self to any solicitous order, since my Circumstances permitted me not to keep one in making those tryals. But before I descend to other Particulars, It will not, I think, be amiss to take notice of a few, that, having more affinity than others with the last mentioned quality of our *Phosphorus*, seem proper to be annexed to what has been delivered of it.

OBSERVATIONS

About The

WATER

Wherein the

NOCTILUCA

Was kept.

SECT. IV.

BEcause I guessed that the Water wherein the *Noctiluca* had been long kept covered, to fence it from the Air, though it did not manifestly dissolve the Mass, yet might be impregnated at least

C 4

with

with the more *Saline*, and on that account resolvable parts of it, I thought fit to make a few tryals upon this Liquor.

Experiment I.

And First, I found that it had a strong and penetrant taste, that seemed near of kin to that of Sea-Salt, but was more piercing, as if Brine were mingled with Spirit of Salt, and it relished also somewhat of Vitriol.

Experiment II.

Being put into a small concave Vessel of Refin'd Silver upon lighted Coals and Ashes, it evaporated but very slowly, and would not be brought to shoot into Crystals, nor yet to afford a dry Salt, but coagulated into a Substance sometimes like a Gelly, and sometimes, as to consistence, like whites of Eggs; which Substance was easily melted by heat.

Experiment

Experiment III.

When this Substance was kept a while on a hotter Fire, it only boiled at first, but soon after began, as I guessed it would, to make a crackling noise; wherein, this was remarkable and pretty, that the Explosions were accompanied with flashes of Fire and light, which if they were small, were generally very Blew, like the Flames of Sulphur, but more Vivid, and sometimes also more Blew; but the greater cracks, whose noise was considerable, were wont to appear of a Yellow colour and very Luminous. And these *Phænomena* did not only appear whilst the Matter was Boiling over the Fire, but a pretty while after the Vessel was taken off and held in the Air.

Experiment IV.

If before the Coagulated Matter were too far wasted by the heat, it
were

were suffered to coole a little, it appeared to have acquired a consistence like melted Rosin; or rather stiff Bird-Lime, for it would draw out into Threeds of, perhaps, a Foot or more in length; and having held one of these Threeds to the Flame of a Candle, it did not take Fire, but melted into little Globul's, as capillary Threeds of Glass are in like circumstances wont to do. And having made some of them stick to the wieck of a Candle, towards the bottom of the Flame, they Coloured the lower part of the flame quite round with a very fine Blew, which lasted much longer than one would have Expected.

Experiment V.

This glutinous Substance had, by the Action of the Fire, acquired an odd kind of strong smell, almost like That of Garlick, and being left all night in the Air, attracted to it (to use the Vulgar Phrase) the moisture

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sture of it, exceeding fast, being dissolved in a good part into a Liquor almost as strong as Spirit of Salt.

Experiment VI.

Putting this Substance again over the Fire, as before, it appeared to be more fixt than one would have looked for, for though there were not so much as a Spoonful of it, yet it continued Boyling for a great while, and afforded a Multitude of shining *Explosions*, whereof some made a considerable noise, and gave notable flashes of Light, which seemed to be made by condens'd and agitated Fumes, suppressed by the somewhat hardned Surface of the Matter, and kindled in their eruption into the Air, into which some parts of these Fumes, that were not kindled, escaped in the form of a Smoke, whose smell was very strong and rank, but of a peculiar kind. To which I shall add, what seemed strange, that though oftentimes two, and sometimes more flashes appeared

appeared at once, yet so small a quantity of Matter continued to afford them for almost an hour together, and probably would have done it longer, but that the late time of the Night obliged me to go to Bed, before the Experiment was finished.

*What Liquors would, or
would not dissolve, the
Icy Noctiluca.*

SECT. V.

AMong other ways of investigating the Nature of our *Icy Phosphorus*, I thought fit to try, whether or no it would be dissolved in some Liquors of differing kinds, hoping, that if it would be so in any of them, it might somewhat assist us to guess at its Texture.

Experiment I.

We found then by tryal, That common Water would not in the Cold dissolve it, though the Liquor was thereby Impregnated, as when *Crocus Metallorum*, or Glafs of *Antimony*, being infused in Wine or Water,
the

the Menstruum will be Impregnated by its Emetick Particles, and yet the Bulk, Shape, and Colour of the Crocus, or the Glass, will not thereby be visibly diminished or altered.

Experiment II.

Afterwards we put a Grain or two of our Lucid Matter into a little Urinous Spirit of *Sal Armoniac*, but it seemed not to make any conflict with it, nor manifestly to work upon it, though, to give the Liquor time to make a Solution, we left them together for several days. But as soon as we had poured aside the Spirit, it appeared that it had not by any contrariety destroy'd the power of the *Noctiluca*, which began readily to shine as formerly, and yet, might be immediately suppressed again, by suffering the Liquor to cover it as before; but when we had, by keeping the Phial for some time in a moderate heat, Impregnated the Liquor with it, this Liquor, being then dropt
into

into Water, had a like effect with
That mentioned in the Experiment
of Impregnated Spirit of Wine.

Experiment III.

Seeing a Volatile and Urinous Salt
would not work sensibly upon our
Phosphorus, we thought fit to try,
what Corrosive Liquors would do,
and accordingly, we put a Grain or
two of our Splendent Matter into a
very small Phial, wherein was a lit-
tle Oyl of *Vitriol*, that Menstruum
appearing, in many cases, more Cor-
rosive, than other vulgar *Acids*, but
neither did this Menstruum dissolve
our *Icy Noctiluca* in the Cold, and
therefore putting it in some heat, we
found, that though it did not mani-
festly dissolve the shining Matter,
yet the warmed Oyl made it melt,
and appear at least for the time a
fluid Body; in which this seemed to
me remarkable, that this so fugitive
a Substance should be ponderous
enough to lye at the bottom of Oyl
of

of *Vitriol*, which is one of the heaviest Fluids we yet know, except *Quicksilver*, which many will not allow to be a *Liquor*. What we did with this melted *Noctiluca* was not unpleasant to see, and will, God permitting, be hereafter mentioned.

Experiment IV.

Afterwards we put a small Fragment of our *Icy Phosphorus* into *Aqua-Fortis*, and though we kept it in that Menstruum, two or three Days, and set the Vial that contained them for many hours in a warm place, (the Chimney Corner) yet we found the Matter so little altered, as to its visible appearance, that we doubted whether the *Liquor* had dissolved any sensible quantity of it.

Having tryed Saline Menstruums upon our *Icy Phosphorus*, I thought fit to try Oyls, and also Spirit of Wine, that is reckoned by Chymists to be of great affinity with them.

Experiment

Experiment V.

Whereupon I put a little of our *Noctiluca* into some Oyle of *Turpentine*, which not dissolving it in the Cold, the small Vial that contained it, was left all Night in the Chimny upon warm Ashes. But though the next Day none of the *Phosphorus* appeared any longer in the Glass, yet we could not perceive by two or three differing Tryals, that the Oyle was much altered by it, and particularly I observed that though the Glass were unstopt, and kept so for a while, yet the Ingress of the Air did not produce any sensible light, nor did we perceive the upper part of the Glass to be full of white Fumes, as is usual in divers other Liquors Impregnated with our *Noctiluca*, when they are unstopt.

D

S E C T

SECT. VI.

IT has rendred the Experiments made with the *Aerial Noctiluca*, much less acceptable, than otherwise they would have been, to the delicate sort of Speculators, especially to Ladies, that the Light they produced was accompanied with a very unpleasant smell, that issued out of the Phial whenever it was unstopped, to let in the Air. But by the help of our *Icy Noctiluca*, I found a way to prevent this ungrateful concomitant of our Artificial Light. But not being discouraged by the bad success of the forementioned Experiment, I hoped an *Aromatical Oyl* might do, what *Subtil Oyles* had not done.

Experiment I.

And therefore having in a very small Phial put about a Grain of *Noctilucal Matter*, and cover'd it with as much pure Essential of *Cinamon*, as
would

would swim less than a Fingers breadth above it, we carefully stopt our little Phial, and having warily held the bottom of it against a Fire, till the *Phosphorus* began to melt, I suffered it to Cool; and then unstopping it in a dark place, had the pleasure to see produced a Vanishing indeed, but a Vivid Light. So that by this means I could afterwards shew the production of Light to the nearest Persons of Quality, not only without offending their Noses, whilst their Eyes were gratified, but with adding to the pleasure of a delightful Apparition, That of a Fragrant smell. But because Oyle of *Cloves* is more easie to be had good, than the Oyl of *Cinamon*, and is also much cheaper, I tryed the Experiment more fully with That, and therefore shall proceed to give you (for an Example of *Aromatick* Oyles) the *Phænomena* of it.

D x

Experiment

Experiment II.

We put some of our Luminous Ice into a little pure Oyl of Cloves, such as the *Chymists* call Essential, but found after a considerable time (no less than some Days) that at least a good part of the Matter was undissolved, but yet the Liquor was richly Impregnated by it, as we found by a pretty *Phænomenon* that it afforded us. For the little Phial, it was kept in, being opened in a dark place, there immediately ensued a kind of flash of Light, far more Vivid, its small Bulk considered, than any Liquor had afforded us before. But the brightness of this Apparition was it seems too great to be lasting, for this Flame-like Substance usually expired in less than a Minute of an Hour, sometimes perhaps in half that time. And there were two other Circumstances particular enough in this *Phænomenon*; One, that sometimes, especially if a Candle were in the Room, the shining

ning *Fluid* would appear of a pleasant and somewhat surprizing Blewish Colour. And the *Other*, that the Light would cease whilst yet there remained in the upper part of the Glass pretty Store of Whitish Fumes, such as we have formerly often Observed in the *Aerial Noctiluca* to be the usual Causes or Concomitants of Light, as if in our present case the shining Substance prey'd on, or resided in only the finer and more delicate Particles of the Whitish Exhalations.

Experiment III.

Instead of the Oyl of *Cloves*, we substituted some *Chymical Oyl* of *Mace*, into which we put a competent quantity of the Glacial *Phosphorus*; but though we warmed the bottom of the Phial, at least as much as we judged necessary, yet, upon the unstopping of it, there appeared no sign of Light, though the tryal was made much more than once or twice,

and sometimes with favourable Circumstances, which event was the less expected, because the Oyl, made use of, was presented me as very pure, by the same Traveller who gave me That of *Cloves* newly mentioned. And because also the Warmed *Phosphorus* was so well conditioned, that as soon as ever the Oyl was removed, it shone with a somewhat extraordinary Vividness.

Experiment IV.

We made also a Tryal or two with Distill'd and Fragrant Oyl of *Aniseeds*, to see, if That being an Essential Oyl as *Chymists* speak, and being look'd upon by many as a kind of *Aromatick* Oyl, it would better dissolve the *Noctiluca*, or be Impregnated by its *Luciferous* parts; but we found that it neither dissolved the Matter, nor upon the unstopping of the Phial, that contain'd it, did it afford any Light, or so much as Whitish Fumes, which seemed somewhat strange, because

cause the Oyl was very subtile, and by its aptness to *Coagulate* of it self, shewed that it was Genuine, and not as Chymical Oyles that are Venal too frequently (if not most commonly) are, *Sophisticated*.

If these two last recited Experiments prove constant, they will argue that not every *Fragrant*, no, nor every *Aromatical* Oyl, properly so called, has the like operation upon our Noctilucal Matter, as the Oyl of *Cloves* and *Cinamon* have.

If I had had or could have procured other Essential Oyls, on whose Genuineness I could have depended, I had try'd their effects upon our *Phosphorus*.

Experiment V.

But having no more Oyls fit for my turn, I next tryed whether I could dissolve our shining Matter in Ardent Spirits, which are thought by *Chymists* to be of near Consanguinity with distill'd Oyls; (not

now to enquire, whether they do not consist of the finer parts of the highly rarified Oyl of Bodies, united with a great proportion of their *Phlegm*) and having accordingly put some of our *Icy Phosphorus* into the Spirit of wine, though the Menstruum did some hundreds of times exceed the Body 'twas to work upon, yet after divers days, wherein it stood in a Window, exposed to the Sun Beams, in the hottest part of the Summer, it appeared undissolv'd at the bottom of the Liquor, and scarce sensibly diminished. But of the separation of Spirit of Wine upon the *Noctilucal* Matter, further tryals will require, that more be said hereafter,

Of a way of suddenly producing Light in common Water, by the help of another, not Luminous, Liquor.

SECT. VII.

I Come now to recite to you a *Phænomenon* which I presume may not displease you. I had a hint of it from a casual Observation made by my industrious Laborant. For having, to incourage him, allow'd him for his own use some Fragments of our *Icy Noctiluca*, he mingled a portion of this shining Substance with a Spirituous Medicinal Liquor that he had prepared, by extracting several Drugs with it, and having afterwards upon some occasion or other diluted it with Water,

ter, it afforded him a *Phænomenon*, at which being surpriz'd, he came to acquaint me with it, bringing me withal some of the Liquor. But I thinking that the *Phænomenon* did not depend upon the Peculiar Nature of the Liquor, whose being very Compounded and high Coloured made me judge it not fit for *Luciferous* Experiments, but proceeded from the Vinous Spirits wherein that Liquor abounded, I thought fit to make the Experiment with a Liquor as Colourless and Simple as I could. The effects of such Liquors being more easie to be discerned, and judged of, and reasoned upon. And accordingly we weigh'd out in a tender Ballance one Grain of our *Glacial Phosphorus*, wiped dry, and broken in four or five pieces, for the easier dissolution. And to these in a *Crystalline* Phial, we put a convenient quantity of highly Rectified Vinous Spirit, and stopping the Phial close, we suffered the things contained in it, to remain for many hours, sometimes (and indeed

deed for the most part) in the Cold, and sometimes in the Warm Sun, but perceived not that near a total dissolution was made of the *Noctilucal* Matter by the Liquor in which it lay, even one of the lesser Fragments appearing, as well as the others, undissolved in the bottom of it. However, since a Body consisting of such subtile parts may communicate many of them to a contiguous Liquor without any diminution of its Bulk, observable by the Eye, I thought fit to try what Effects this Body had upon the Vinous Spirit.

Observation I.

And First, I Observed, that it did not manifestly discolour the Liquor, but left it Transparent and Limpid, as before, save that there appeared some very small Earthy Corpuscles, like Dust at the bottom of the Liquor, when being a little shaken (to raise them) it was attentively view'd.

Observation

Observation II.

We did not Observe that, upon the unstopping of the Phial, and the restored commerce between the inward and outward Air, there appeared any flame or Luminous Exhalations, as is usual upon opening Phials that contain the Liquid *Aerial Noctiluca*.

Observation III.

But the *Phænomenon* I chiefly intend to relate was This, That, having in a dark Night dropt a little of this Impregnated Spirit into a small *China* Cup, with common Water in it, though the Spirit neither in the Phial, nor in its passage through the Air, disclosed any degree of Luminousness, yet as soon as ever the drops came to touch the Liquor, they would be as it were kindled by the Cold Water, and afford little flashes of Light, which was more Vivid

Vivid than the *Noctiluca* it self, affording a Splendor that made not only the brims of the Cup, but divers of the Neighbouring Objects manifestly Visible, not to say conspicuous. But these *Coruscations* had the property of other Lightning, to vanish almost as soon as they appeared, nor would the Water, that produced them, by being agitated, shine; but others might immediately be produced, by letting fresh drops fall into the same Water, upon whose Surface they seemed to diffuse themselves, and would sometimes leave for a little while a faintly Luminous as it were Film or Membrane.

Observation IV.

And that it might not be thought that this accension (if I may so call it) was produced or occasioned by any *Antiperistasis*, which the School-Men, and the generality even of *Philosophers*, are pleased to fancy (whose Opinion I have in a particular discourse

scourse examined) I thought fit to try, whether our *Phænomenon* would not be produced with *hot* Water as well as with *cold*, and accordingly I found that the Impregnated Spirit of Wine produced rather a greater than a lesser Light in hot Water than it had done in cold.

One of my designs, I had in making this Experiment, being to examine a conjecture I had made about the great diffusedness of the *Noctilucal* Matter, the subtilty of whose Particles made me think they were not to be judged absent where ever they were not numerous or agitated enough to be of themselves Visible: this I say being in my thoughts, I judg'd it not fit to put our Splendent *Icy* Matter into the Spirit of Wine at adventures. Wherefore having in a very good Ballance weighed out one Grain of our *Noctiluca*, (first wiped dry,) we put to it at several times, that it might the better dissolve, above two thousand Grains of Spirit of Wine, that would

burn

burn all away ; and yet, which may seem strange, this small quantity of *Noctilucal* Matter did so Impregnate all the Liquor put upon it, that though nothing of Luminous did appear in the Menstruum nor in any Exhalations rising from it, though the Phial were unstopped, or the Liquor poured out of it into the Air, yet as soon as ever 'twas dropt into common Water there would be produced a Vivid Apparition of Light, such as has been a little above described.

It seemed not very improbable, that these suddain and vanishing flashes might, at least in great part, proceed from the quick disengagement and extrusion of the *Noctilucal* Particles, made by the Water, which, diluting the Vinous Spirit, disabled them from retaining with them the Luciferous Corpuscles. As if into one Ounce of high rectified Spirit of Wine, you put half a Dram, or a Dram of *Camphire*, the Liquor will dissolve it, without being thereby manifestly altered

altered as to Colour or Transparency; but if you drop this solution into common Water, the Vinous Spirits will immediately diffuse themselves into the Liquor, and let go the Corpuscles of the *Camphire*, which will Float like a White Powder upon the Surface of the Water. To this Conjecture is agreeable what upon Tryal we Observed with our Impregnated Spirit of Wine namely, that being dropt into other, well *Deflegmed* Spirit of Wine, we saw no Light produced; but when it was dropt into an Urinous Spirit of *Sal Armoniac*, which seems to consist of the Volatile Salt dissolved in the Phlegm or Aqueous Liquor, the *Noctilucal* Corpuscles by this Watrish part were freed from the Vinous Spirits, almost as much as they would have been by common Water, and did accordingly shine with much briskness.

Experiments

EXPERIMENTS

Discovering a Strange

SUBTILTY

Of parts in the

GLACIAL NOCTILUCA.

SECT. VIII.

BUT what has been above recited, is not all that I thought fit to try with the shining Matter, that I told you we dissolved in Spirt of Wine, for after having, as I lately recited, brought one Grain to Impregnate between four and five Ounces of *Alcohol*, as the *Chymists* call the high Rectified

E Spirit

Spirit of Wine, which did at least two thousand times exceed the weight of the *Noctilucal* Matter, I presum'd that this very parcel of Spirit of Wine, wherein the shining Matter was already diffused and scattered into so many thousand *Corpuscles*, as sufficed to Impregnate all the Liquor, would yet communicate to a good quantity of Water Particles enough to make it shine, when agitated, wherefore when we had weighed out in a very trusty Ballance one Dram of our Impregnated Spirit of Wine, we mixed it with, and shook it in as much fair Water as we thought fit, (but not all at once) that is till we had to our Dram of Spirit of Wine, put above fifty times its weight of Water, and that *Alcohol* it self weighing at least two thousand times as much as the *Noctilucal* Matter, that Impregnated it, it follows, (though it may seem strange it should be true,) that the single Grain of *Icy Noctiluca* was able to Diffuse it self through, and Impregnate full a hundred thousand Grains of Liquor,

so

so as (when duly ordered) to make it Luminous. For having presently after the last Water was put into the Glafs, stoppt the Vessel Close with a good Cork, and shaken it a little in a dark place, the whole Phial appeared to be full of Light, which though it were not more than ordinary intense, yet by reason of the Bulk of the Liquor made a glorious shew, and discovered divers of the Neighbouring Objects. And after we had done shaking that Phial, not only the upper part, which was fill'd with Exhalations and Vapours, shined like those other Liquid *Phosphorusses* formerly mentioned, but what was not observed in Them, the Water it self had a Luminousness, though of an inferiour degree, of its whole Mass, which yet will not keep me from thinking of some expedient that may satisfie those who may suspect, as I did, that some of this Light proceeded from the Exhalations that shined through that *Diaphanous* Water, though this did not seem the only nor perhaps the chief cause of its appear-

ing Luminous, since when the Glass was shaken, the whole Mass of the Liquor appeared to shine, so that we could plainly see through the sides of the Vessel, the Conical Figure of its bottom.

After this, I prosecuted the Experiment a good way further, encreasing the proportion of the Water to fresh Impregnated Spirit, and I found (what perhaps you will think strange) that one part of the *Noctiluca*, being first dissolved in *Alcohol* of Wine, and afterwards briskly shaken into a convenient quantity of Water, rendered Luminous as much Liquor, as upon Calculation amounted to four hundred thousand times its Weight. And this did not seem to proceed from the Irradiation of the Luminous Corpuscles or Exhalations, shining in the empty space at the top of the Glass; because the Phial was so near fill'd with Liquor, that there was but little room left for Vapours; and because also, the Vapours, that did play in that space, shined but very faintly,

faintly, and when the Glass was at rest much less than a minute of an hour, the Light would reach but a little way downwards in the Water, and yet was there so dim, as to be scarce discernable. Whereas in our Experiment, not only the agitated Liquor appeared Luminous throughout, but the Light was brisk enough, insomuch that the *Conical* Figure of the bottom of the Glass was clearly visible by the help of it.

But lest some should think, that if this Experiment had been further and further prosecuted, the Luminousness would have still extended to greater and greater quantities of Water, I shall add, that when I increased the proportion of this Liquor to the *Noctilucal* Matter, to be dispersed through it, by putting in near three or four ounces of Water, more than I guessed would be convenient, the Luminous Matter seemed to be as it were drowned or lost in so much Liquor, for though we gave it much more agitation, than

had in the former Experiments been needful to produce Light, yet no Luminousness at all appeared in the mixture. Wherefore, taking some fresh Spirit, and shaking it into such a quantity of Water, as I thought it might serve to Impregnate, I found by Supputation, that the Luminous Mass of Liquor, thereby produced, amounted to no less, but a pretty deal more, than five hundred thousand times the Weight of the *Noctilucal* Matter dispersed through it, which is a visible expansion, very much greater, than, I think, has been hitherto observed in any Corporeal Substance dissolved in a visible Liquor, since it four times exceeds that expansion of *Cochineal*, which I many years since imparted to the ingenious, and which several of them have in their Writings, been pleased to take notice of, as a prodigious thing; one part of the *Cochineal*, ordered as I there mention, having in that Experiment produced a discernable Colour in an hundred twenty five thousand parts of

of Water. To what has been said, I shall add these three Circumstances, which may encrease the strangeness of the Experiment.

1. The first is, that I here only delivered the manifest Impregnation of the Water it self, which is a gross and tangible Liquor, by the dispersed Particles of the *Noctilucal* Matter, but have made no estimate of the incomparably greater expansion of the Light, that from the Matter included in the Phial, illuminated the Ambient Air, to a considerable distance from it, though by reason the darkened Room was not great, I was disabled to make an Estimate how far the Enlightened Sphere of Air might have extended.

2. The Second is, that this Experiment was not favourably made, but rather invidiously, since we purposefully weighed out somewhat less of the lucid Matter, and now and then more of the Water, than the precise quantities that calculation supposes,

that I might be sure the Experiment was made severely enough.

3. And lastly, upon search I found that the grain of *Icy Phosphorus*, that was first put into the Spirit of Wine, we made use of all this while, was not, though after so long a time, totally dissolved; a small Fragment, amounting to about an eighth part, if not more, remaining at the bottom of the Phial; upon which having poured some fresh *Alcohol* of Wine, and kept it a while in a little heat, to further the dissolution, I found That Liquor did, as I thought it would, grow very Luminous, when dropt into common Water, so that it seemed probable, that if the whole Grain of *Icy Phosphorus* had been dissolved at first in the Spirit of Wine, it would have Impregnated above six hundred thousand times its weight of Water, sufficient to make it shine.

SECT.

SECT. IX.

I Come now to another way, by which I thought the great Subtilty of parts in our *Noctilucal* Matter might appear with good advantage, and possibly you will think by the success, that I missed not of what I expected from the intended Tryal.

Experiment I.

We carefully weighed out a small lump of our shining Matter, amounting to three Grains, and having purposely broken it into divers lesser Fragments, perhaps six or seven at least, we laid them upon a flat bottom'd Glass, that was broader at the top than the bottom, and shallow too, (not being near an Inch deep) that the Matter might be more fully exposed to the free Air. This Glass we placed in a South Window, laying it very shelving, that the Liquor

quor to be produced, by its resolution in the moist Air, might presently run down, and not hinder the free Evaporation of the remaining Matter. In which posture of the Glass, we had also another aim, to be hereafter mentioned. The Vessel being thus placed, about ten of the Clock at Night, all the Fragments of the *Noctiluca* shined briskly, and so continued to do, till most of them were resolved into other Substances, and the biggest of them continued to shine till they were reduced to such a smallness, that they would scarce have been seen, had not their own Light made them visible. But the main thing that I am to take notice of in this Experiment, (and which perhaps will somewhat surprize you,) is, that so little quantity of *Noctilucal* Matter continued to emit visible Fumes for a good many more than an hundred and fifty Hours, and this with Circumstances that made the thing more strange.

I. As First, That this Smoke was not only visible but manifest, and that
as

as well in the Night (as I often observed from time to time) as in the Day.

2. Secondly, That the several Parcels of Matter did each emit these Fumes all at once, as if it were from so many little Chimneys.

3. Thirdly, That this Smoke was so Copious, and withall so Tenacious, that it would easily retain the form of Smoke at a considerable distance from the Bodies that emitted it, so that as I walked to and fro in the Room, a careless look towards the Glass would often discover it to me, and sometimes it would manifestly appear at a distance, that I estimated to be near a Foot from the Matter that afforded it.

I shall now add, to another purpose, the following Circumstances; namely,

1. First, That the motion of the Smoke was swift enough, considering that it had no Channel or Chimny to assist it. It was not always, nor for the most part, directly upwards, but sometimes Horizontal, sometimes downwards, sometimes towards the right hand,

hand, and sometimes towards the left, as if the motion of the Fumes had been determined by the situation of those parts of the *Noctilucal* Fragment, by which they were emitted, and as 'twere discharged; I use this last expression, because taking pleasure to watch attentively the Circumstances of our delightful Experiment, I thought, I many times observed a kind of Palpitation or *Æstuation* in the little shining Fragments, which I gathered from the Apparent great inequality I perceived in the plenty of the Smoke, that was emitted at several times, all of them perhaps within the compass of a minute or two. But on this I forbear to discourse, till I shall have made further observations; and therefore I shall proceed to take notice of one Circumstance more in our Experiment; which is,

2. Secondly, That even in the latter part of it, after the shining Matter had been so long exposed to the Air, it emitted a smell strong enough; which

which seemed to be caused by odorous Exhalations, distinct from the visible Fumes.

SECT. X.

AND now 'tis time that I give you some account of the reason, (that I but pointed at before,) why I chose such a Glass, and kept it in a shelving posture; this I did, that I might not lose, but preserve the Liquor, which I knew would fall from the Saline part of the shining Matter, which Liquor I thought fit to Examine in order to discover certain things; particularly, whether the Limpid Water, as it appeared to be, that was as 'twere the *Cadaver*, or, to employ *Chymical* terms, the deliquated *Caput Mortuum*, of the shining substance, did not yet contain something, as well Luminous as Saline.

Experiment

Experiment I.

To fatisfie my felf about this, I caufed this Liquor to be put into a fmall concave Veffel of carefully refined Silver (that other Salts than *Nitre* and *Allum* might not *Corrode* it) which I had purpofely provided for the quick Evaporation and Criftallization of fmall quantities of Matter. Our Liquor, being in this Veffel put upon fome fmall Coals and Afhes, did not Evaporate near fo eafily, as one would have thought, but turned into an *Unctuous* Subftance, of a dark Reddifh Colour; wherefore we placed the Veffel upon quick Coals, that by their brisk heat they might make the Liquor boil, and free it from fuperfluous moiifture. By this means after a while it was reduced to a Subftance that afforded us a pretty *Phænomenon*, not unlike to That elfewhere mentioned, where we fpake of the Infufion or Solution of the Solid *Phosphorus*

rus in common Water. For the boiling Liquor crackled like a handful of Bay-Salt cast into the Fire, and whilst these cracklings continued, (which they did much longer than one would have expected) they imitated little Volleys of Shot, not only in the great number of the Noises they made, but in the little flashes that accompanied them, which flashes, when the Fire was somewhat encreased, were so many, and followed one another so fast, that they appeared to make up a continued flame, not unpleasant to behold.

Experiment II.

After the foregoing Experiment, I had a mind to be able to make some estimate, how far the breaking of the shining Matter into Fragments, and the conditions of the Vessel contributed to the quick consumption of it. To this purpose, we took a lump of three Grains, carefully weighed out, and put it into a small Glass Funnel,

Funnel, whose upper end was wide and capacious enough, in reference to the lower part, which was exceeding slender, that the *Noctiluca* might have Air both above and (often-times) below, and yet the Matter might not slide down, till it were so wasted, as to be less than a small Pins head; a Vessel of this shape I chose to make use of, that I might catch the Liquor, that would be afforded by the deliquation of our *Icy Phosphorus*; for which purpose the slender pipe of this Funnel was put into the Orifice of a small *Cylindrical* Phial, and there kept in a quiet place, which was a South-Window, from whence every Night, after I was in Bed, I caused it to be brought into my Chamber, to see if it continued to shine. By which Tryals, I found that it remained Luminous, and was not yet so wasted, to fall quite through the Funnel into the Phial, at somewhat beyond the end of the Fifteenth day; so that it continued to shine, three hundred and sixty Hours.

The

The very Limpid Liquor, that was brought into the Phial by this Experiment, was unhappily lost before I could make any Tryals with it, but not before I had done the chief thing I aimed at, in saving of it, which was to know its weight to be by and by mentioned.

What has been hitherto related, may justly enough make a Man reflect, with some wonder, upon the strange minuteness and multitude of parts, that are crouded together in our *Noctilucal* Matter; if we consider what a multitude of Luminous Beams of visible Smoke, of Odorable, though unseen, Effluvia, so small a quantity of it, as three Grains, which are but the twentieth part of a Drachm, could incessantly afford for two or three hundred hours; leaving after all this behind it above three times its Weight, (for so we found it to be) of a Liquor, which it self was not a Cadavorous one, or, what it looked like, common Water,

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but

but (as may be argued from what was lately recited of the same kind of Liquor) might have been Impregnated with very many Saline parts, and not a few capable of shining briskly.

O-B-

OBSERVATIONS

About the

INFLAMABILITY

Of the

NOCTILUCA

It self.

SECT. XI.

Observation I.

I Took a little of the Consistent *Noctiluca*, and having broken it, and, as its brittleness would permit, spread it here and there, upon a piece of folded Paper, I lighted that

F 2

Paper

Paper at the flame of a Candle, and observed, that when the flame reached This or That little Fragment of the shining Matter, it would take Fire, and burn away in a flashing and very sputtering manner, accompanied with noise, almost as Grains of Salt *Petre* are wont to do, when they are put upon a live Coal.

Observation II.

I observed also, that if I put pieces of Paper, on which I had placed some of these Grains of *Noctilucal Matter*, upon some Embers covered with Ashes, before the paper it self took Fire, the shining Matter would communicate its flame to the Contiguous Paper.

Experiment I.

We took a Fragment of our shining Matter, not amounting to a Grain, This we put into half a Spoonful or less of high Rectified Spirit of Wine,

Wine, and kindling that Liquor with the flame of a Candle, the Spirit burned away, as is usual, in a flame partly Yellow, (and especially at the out side) but chiefly Blew : But though the heat of the Silver Spoon, wherein the Tryal was made, did quickly (as might well be expected) melt the *Noctilucal* Matter, and gave it a Globular form, yet it continued at the bottom without manifestly mixing with the Vinous Spirits, or considerably altering the Colour of their flame : But when the Spirit of Wine was all consumed, without leaving any jot of Phlegm behind it, the last drops coming, when they were actually kindled, to touch the shining Matter, presently set it a Fire, but its flame was very differing from that of the Vinous Spirits. For besides somewhat that was odd in its Figure, its Colour was not at all Blew, or Blewish, but of an intense Yellow, and burned so fiercely, and with so Vivid a Light, as was somewhat surprising to behold, and continued to Burn a

pretty while, considering the paucity of the combustible Matter. And whilst it burned, it emitted good store of Smoke, that seemed to be darted up to a considerable height, the Matter did not burn all away at first, but left a kind of *Caput Mortuum*, which lay in the form of a little Cake, partly of a deep Yellow, and partly of a fine Red. This Matter being more Bulky in proportion to That, That was consumed, than I thought it likely that so little of the *Phosphorus* should contain of incom-
 bustible Matter, I proceeded to burn it, as elsewhere will be related after another manner, till there remained but some very few light feces, that seemed to be of the same nature, with Those that are to be mentioned in the next Experiment.

Experiment II.

We took a small Fragment, not amounting to a Grain of the *Nocti-
 lucal* Matter, and putting it into a
 Silver

Silver Spoon, we cast upon it the Sun-beams concentrated by our smallest (*Dioptrical*) burning Glass; by These it was presently set on Fire, and afforded, together with a great deal of Smoke, a flame exceeding Yellow, and so very fierce and bright, that it was conspicuous; though the Window being purposely set open, the Beams of the Sun, then in the *Meridian*, were suffered to beat full upon it, and a brisk Wind did also blow upon it without extinguishing it. At the bottom of the Spoon, the expiring flame left a round and broad *Caput Mortuum*, consisting of divers Circles, like those of a *Sardonix*, whereof the largest was White, another Yellow, and the third Red, all the three Colours being Pleasant and Vivid enough. Some part of this *Caput Mortuum*, being again brought to be freely touched by the Air, appeared Combustible, and the rest being left in the Spoon, that the Air might work upon it, did for the most part soon resolve it self *per De-*

Liquium into a Liquor, almost as sharp as Spirit of Salt, the rest being a light Black Feculency, of which, because there was so very little of it, we could make no Examen.

Experiment III.

Being desirous to try, whether the *Noctilucal* Matter would, by bare pressure or motion, be brought to Burn, I thought not fit to depend upon such other Experiments, as are here related, wherein it appears able to set Fire on divers Bodies, belonging to the vegetable kingdom, or are otherwise easily inflamable, wherefore we put two Grains of our dried *Noctilucal* Matter into a Glass Morter (furnished with a Glass Pestle) whose coldness and thickness were able to keep it from being put into any sensible heat by the operation, that was to be performed in it, and consequently from communicating any heat of *its own* to the *Noctilucal* Matter. This was pretty briskly rubbed

in

in the Morter, with the Glass Pestle, but though it was thereby brought to shine much more Vividly than before, yet it did not take Fire, which I was apt to impute to the great coldness of the Glass, which much opposed the *Incalescence* of the *Phosphorus*, but after a while longer it took Fire, and began to burn away in an actual flame, with much Smoke: But this did not last so long, as might have been expected, which short duration might proceed from the Vessel, that continued sensibly cold, and perhaps also from the narrowness, and depth of it, which somewhat hindered the free access of the Air; for some Matter, that was taken out on the Pestle, seemed to Burn better, than That which remained in the Morter, which being extinguished, was once more kindled by Trituration, but soon expiring again, could not by the same means be rekindled, but only was brought to shine briskly,

EX.

EXPERIMENTS

About

BURNING

Other

BODIES

With the

NOCTILUCA.

SECT. XII.

I Formerly intimated that our consistent *Noctiluca*, notwithstanding the appearance it had of *Ice*, and its actual Coldness to the touch, was much disposed to have

TS have its parts easily put into motion, and might by that means be brought to be sensibly hot. And I think it time now to proceed to make this good by particular Instances.

S 1. And First, If our *Phosphorus* be for any time pressed hard between ones Fingers, or against a Board, or some such hard and not very cold Body, it will oftentimes be felt actually and very sensibly hot, and sometimes the degree of heat will be so vehement, as to Scorch the Skin, as my venturous Laborant found several times to his no small pain, his Fingers being almost covered with Blisters raised on them, by handling our shining Matter, with too bold a curiosity: And he complained to me, that, though according to the usual fate of *Chymists*, he had been often Burned on other occasions, yet he found Blisters, excited by the *Phosphorus*, more painful than others; and he is not the only person that has complained to me of their finding the Burning made with this Matter to be

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be more tedious and difficult to be cured, than ordinary ones. But, as our *Noctiluca* was not always made of the same Matter, nor with care equally successful, so I observed its proneness to incalcescence, and the degrees of heat, to which it would be brought by motion, to be differing enough; upon which account, I did not find, that some portions of it, would produce those higher effects of heat, that some others did, besides that these higher effects did gradually differ among themselves.

2. Agreeably to this, after having in vain tryed to Fire Paper by pressing and rubbing some of our *Phosphorus* upon it with the blade of a Knife, I took a piece of fine Paper, and having dry'd, and warm'd it at the Fire, I put a little of our *Noctiluca* in a fold of it, and rubbing the Paper between my hands, though by that attrition there were produced a sensible, and even considerable heat, yet it did not reach to what I desired, but continuing a little while to rub
the

the Paper to and fro, it did on a sudden take Fire, and blazed out, so that it would have Burned my hand, if This had not been kept from receiving *much* harm (for *all* it did not escape) by a thin Glove, that was thereby scorched, and in part shrivel'd up. After the same manner, to make the Experiment the more certain, I fired another piece of Paper, but then desisted, that I might not unnecessarily waste a Substance, wherewith I was but meanly stored.

3. If the firing of Gun-powder could be performed with our *Phosphorus*, without the assistance of Circumstances, whose difficult concurrence will keep it from being more than an instructive Curiosity; the fear that it might be applied to uses mischievous to Men, would keep me silent of the power our *Phosphorus* may be brought to have of kindling Gun-powder, when 'tis befriended with favourable Circumstances. To try therefore, whether our *Phosphorus*, which appeared not inferiour to That of Mr. *Craft's*, would (as His did sometimes, though not easily)

ly) fire Gun-powder, we took a little of our shining Matter, and having a little wiped it, to dry it, we put it upon some dry Gun-powder, and with a Knife pressed it, and in some sort rubbed it upon the Black Grains, but found, that though a heat were produced, and sometimes such as would make some of the *Corns* of Powder have a Blewish flame, yet the mixture would not go off: So that the Laborant, to whom I left the care of reiterating the Experiment in my presence, presuming it would not succeed, scrupled not to hold his Head over it, that he might the better see what change was made in the mixture; but then upon a sudden the powder took Fire, and the flame shooting up, caught hold of his Hair, which made a Blaze, that proving innocent enough, became more diverting, than the smell of the Smoke that succeeded it was delightful.

4. But the same Laborant, who was very helpful to me in varying the preparation of the *Phosphorus*, had a worse

worse misadventure not long after, for bringing me some newly Distill'd Grains of our *Noctiluca*, covered with some of the shining Water, that came over with it, he unluckily broke the Glass in his Pocket, whereupon the heat of his Body, encreased by the motion his long walk had put it into, did so excite the Matter, that was fallen out of the broken Phial, that it Burned two or three great holes in his Breeches, before he could come to me to relate his misfortune, the recent effects of which I could not look upon without some wonder as well as smiles.

5. Having already told you the effect of our *Noctiluca* upon Gun powder; I thought fit to try, whether it would not kindle a Bodie, that is thought somewhat less prone to take fire. And *Exper.* accordingly having put together about half a Grain of our dry *Noctilucal* Matter, and six times its weight of common flowers of Sulphur, they were lodged in the fold of a Piece of White Paper which was laid upon a Board, and when I had a little bruised
and

and rubb'd This with the Haft of a Knife, it fhone through the intercepted Paper very Vividly, but did no more: Wherefore, fufpecting that the want of Air was the caufe why it did but fhine, not burn too, I opened the Paper, and found that as foon as the Air had access, it took Fire and furiously Burned the Paper, and, if I had not been wary, had burned me too. Another time, the fame Experiment being try'd, afforded this notable *Phænomenon*, that the Ingredients, being well rubb'd together in folded Paper, though before the Paper was displaid and expofed to the Air, they did not kindle, yet upon the contact of This, the mixture took Fire, and did not burn away with a flow flame, as Brimftone is wont to do, but flafhed away at once with a great blaze, like Fired Gun-powder, fave that the flame appeared more Luminous.

6. The higheft effect of the heat of our *Icy Noctiluca* was cafually produced by the Laborant, who being defirous to try, whether fome that
was

was newly prepared was good and fit to be brought to me, began to Write Letters with it, upon a piece of Planck, that had been long used in the Laboratory as part of a Stove, and he, chancing to press the recent Matter hard upon this Board, that the constant heat of the place had brought to an unusual degree of dryness, found to his surprize, that he had not only shining but burning Letters: The Lucid Matter having actually set on Fire those parts of the Wood, against which he had strongly pressed it.

G

S E C T.

SECT. XIII.

Experiment I.

TO examine somewhat particularly, to what Family, or Sort of Salts, the *Saline* part of our *Noctilucal* Matter either does belong, or has most cognation with (for I thought it possible it might not fully agree with any known *Species* of Salts, but have somewhat peculiar to it self) I suffered a little of the small stock, I then had, to resolve it self *per Deliquium* into a clear Liquor, and then made with it some of the Tryals elsewhere delivered, by which I am wont to examine what *Species* a Salt belongs to, guessing this Liquor by the taste, and the manner how it was made, to be somewhat, though not altogether, of the nature of Spirit of Sea-Salt: I dropt a little of it upon a convenient proportion of Syrup of Violets, and found that it turned it not Green, as a Volatile Urinous Salt would have done, but
of

of a fine Carnation Colour, such as that Syrup is wont to acquire, upon the mixture of an *Acid Spirit* with it. I found also, that a very little of our *Anomalous Liquor* presently destroy'd the blew Colour, and not the other of a Tincture of *Lignum Nephriticum*.

Experiment II.

I also put some of this Liquor, that came by *Deliquium* from the *Noctiluca*, upon some filings of Copper, which being thorowly wetted, and some of them covered with it, I exposed in a hollow Glass for two or three Days to the Air: and by this means had, as I expected, without the help of heat, a solution of some of the Filings of Copper, the Colour of which was not a deep *Azure*, as if it had been made with a Volatile Urinous Salt; but seemed to partake of Green and Blew, and to be an intermediate or Compounded Colour.

Experiment III.

To make the Saline nature of this Liquor the more manifest, I put some

of it upon powder of Red *Coral*, which it presently fell upon, and Corroded with noise and froth; and putting another parcel of the same Liquor, upon some dry Salt of *Tar-tar*, there presently ensued a fierce conflict between them, whereby some noise and much froth was produced; so that I thought it needless to waste any more of the *Noctiluca* Matter, (wherewith I was but slenderly stored) to make it more apparent, that our Liquor was not, as most *Chymists* would have expected, of an Urinous nature, but belong'd to the Family of *Acid* Salts, and seemed to be near of kin to that branch of them, to which the Spirituous part of common or Sea-Salt belongs.

Experiment IV.

Some *Virtuosi* may be apt to think, that since our *Icy Noctiluca* is of a more Solid Substance than the *Aerial*, and uses to continue to shine much longer, since I say this is so, if the consistent

Phosphorus

Phosphorus were included in a Glass, whence its expirations could have no vent, the Matter being kept from wasting, the Luminousness may also be kept from ceasing. This conjecture being plausible, though the Notion I have of the Nature of our *Noctiluca*, could not promise me a confirmation of the conjecture, yet, to prevent the being blamed for an easily evitable omission, I put some of our dry *Phosphorus* into a clear Phial, capable, as was guessed, to hold about an Ounce of Water, and having very carefully closed this Glass, I laid it aside, and observed it to continue to shine for some few days, after which the Light manifestly decayed, and soon after quite disappeared, though I thought it possible, that it did not altogether so soon expire, as it ceased to be visible to me; because the Whitish Fumes, emitted by the Matter, whilst it continued to shine, had covered the inside of the Glass, with a kind of Whitish Soot, that at length opacating it, might well

hinder a faint Light from pervading the Vessel and reaching our Eyes. But it seems, that the Air included with the *Phosphorus*, either had some vital Substance (if I may so call it) prey'd upon thereby, or else was by the Fumes of the *Phosphorus*, to name no other possible ways, tamed and rendered at length unfit to continue the flame [*sui generis*] of our *Noctiluca*.

Experiment V.

Yet to pursue the design of making a Light more lasting than ordinary, by keeping the Matter from commerce with the External Air, I took some of our *Noctilucal* Matter, that came over with the Aqueous, from which 'twas not so easily separable, but that I thought it best to leave them together, in regard that it shone so well, that it might pass for an excellent portion of the *Aerial Noctiluca*: This we Sealed up in a Glass-Egg (whose bottom had been made flat on purpose, that it might stand without

without leaning) and setting it in a place, where it would be frequently in my Eyes, I observed it from time to time, especially at Night, and found it continue to shine (if I much misremember not) a Week or longer, and that with so little decay of Light, that I was surpriz'd, when, coming in the Night time to look upon it, I found it to shine no more at all, especially since I could not restore any manifest light to it, either by agitation, or by moderately warming the Sealed Glass, that contained it.

Experiment VI.

After many Observations made of the degrees of Light, that our *Icy Noctiluca* afforded, as 'twere of its own accord, without external heat, I thought fit to try whether by the application of a moderate heat of the Fire, the Light might not be much invigorated, and perhaps the *Phosphorus* it self be brought actually to kin-

dle, even in a Close Vessel. This Design, I was the rather induced to prosecute, because I had some hopes, that by this way of encreasing the Light of our *Phosphorus*, though it should not long retain its acquired degree of Luminousness, yet this increase might continue long enough for some not inconsiderable uses. And especially (in case much *Noctilucal* Matter were heated at once) to give Light enough for taking of Gun-powder out of the Gun-room of a Ship, or out of a Magazine, without danger of firing the Powder, which would be a mean to prevent those sad accidents, that have but too frequently happened to Ships, especially of War, of which we had very lately a notable instance in the River of *Thames*. In prosecution of this Design, we took some Grains of our Consistent *Phosphorus*, and having put them into a round Glass-Egg, somewhat larger than an ordinary Hen Egg, fitted with a stem of a proportionable bigness, and about two thirds of a Foot long. This being
Hermetically

Hermetically sealed up, (at least as far as we discerned) the Globulous part of it was warily, and by Degrees, warmed at the Fire, and then we instantly removed it into a dark place, where the included Matter, not only shone by great odds more vividly than before it was heated, but some portions of it were brought to an actual flame, as appeared both by the radiant Splendor of the Burning Matter, and by the condition of the Smoke, it emitted: And yet more manifestly, by the intense heat which the flaming part of the Matter (and not the other parts) communicated to that part of the Glass, which it adhered to; for there the Vessel was not to be so much as touched without inconvenience; and when this flame expired, which it did after no long time, the portion of the lately kindled Matter did no more shine or burn as before, but was reduced to the condition of the rest of the *Noctilucal* Matter, together with which it did for a good while retain a considerable

derable degree of Light, upon the account of the heat, it had been expos'd to, over and above that Luminousness that ordinarily belonged to it.

This Experiment appeared so strange, and was so delightful to those that had never seen it, that partly to gratify the curious, and partly to pursue my own design, 'twas reiterated within the compass of a Month or two, between (if I mistake not) twenty and thirty times, the same Matter being still kept in the same Vessel, though by being melted, and in great part sublim'd by its frequent approaches to the Fire, it was divided into several parcels. But this made the Experiment so much the more pleasant, in regard that sometimes (for it was not always) more than one or perhaps than two portions of the Matter would seem to burn at once. This was looked upon as a very new and scarce credible thing, that one should be able to bring a Bodie to Burn with an actual flame, and for no inconsiderable time,

time, in a Glass Hermetically Sealed, and not large neither. But to deal with *Philosophical* sincerity, I must not conceal from you, that after we had made many Tryals, in the above mentioned Glass, there happened a *Phænomenon*, which gave me some suspicion, that at that time, it was not actually Sealed: But it did not appear, but that it had been very well Sealed at first, and might continue so during several Tryals, for after this suspicion we used this Glass ten or twelve times, or perhaps oftner to make the before recited Experiment, and after all those we could perceive no crack or flaw at all in the ball or stem of the Glass, and found it difficult to get in the point of a small pin into a little hole, which we either found, or, by endeavouring to find one, made at the *Apex*. However, by the things formerly related, it appeared, that our *Noctilucal* Matter would Burn with less vent by great odds, than other fewels known to us, and that a small quantity may be made

made to burn and shine longer, than one would expect. And we were encouraged by what we saw, to hope that if a more considerable quantity of Matter, were put into a conveniently shaped Glass, and assisted with other friendly Circumstances, especially if the Luminousness could be a little heightened, it may be rendred fit to be of some use in Ships, and Magazines of Powder.

If I had been furnished with accommodations, when I first made the foregoing Experiment, I would have pursued the Tryal somewhat further, by making a pretty quantity of our *Noctilucal* Matter, burn several times, in a thin Glass-Vessel, exquisitely closed with *Hermes* his Seal, that, by weighing the Vessel in exact Scales, both before and after the accension of the included *Phosphorus*, I might find whether any ponderable parts were subtile enough to pervade the pores of the Glass, and in case they were not, I then hoped to discover, what change of texture might be made in
the

the Matter of a bodie, reduced to an actual flame, in a Vessel, wherein it could not receive the free Air, nor emit any Fumes or exhalations, which would have been to me a very acceptable Experiment: And perhaps would have prov'd a very instructive one too. Since, as I have in another place complain'd, in the *Analyses*, hitherto made by *Chymists*, either the body exposed to the Fire, has not been actually inflamed, which is the case of Those distill'd in exactly clos'd Vessels, or else there has been some commerce betwixt Them, and the external Air, which may justly render it doubtful, whether the bodies produced by this *Analysis* were the same both for number, nature, &c. that would have been produced in Vessels, exquisitely closed, since we see that Wood, for Instance, burned in a Chimny, affords store of Soot and Ashes, which are very differing bodies from those that *Chymists* obtain from the same Wood, Distill'd in close Vessels.

But

But to trouble you no further with what *I would have done*, I shall add one Circumstance, I observed, in what *was* done. Namely, That sometimes there appeared a little Liquor in the Glass (whether it consisted of some Aqueous Particles, that may be suspected to have lain hid in the *Noctilucal* Matter, or were produced by the actual deflagration of a part of the Matter) and the rest of the Matter by the reiterated operations of the Fire was turned to a Red Colour, which it yet retains.

SECT. XIV.

Experiment I.

I Have formerly related, that upon the immersion of our *Phosphorus* into Water, it would immediately cease shining, and continue without Light, as long as 'twas kept under that Liquor. This gave me a ground to suppose, that, by the interposition of Water between the *Noctilucal*

cal Matter and the Air, the *Phosphorus* may be kept unactive, till it be fitted, by an extraordinary agitation of its parts, to act with an unwonted vigour, when the Air shall come to touch it suddenly; this supposition, I say, induced me to put two Grains of our *Icy Noctiluca* into a small Glass Egg, and pour a pretty quantity of Water on it: In order to the following Experiment, we heated the Liquor well, yet without making it at all boil, and thereby melted the little Fragments of Solid Matter, and made them flow into one Liquid Mass, that kept it self at the bottom, distinct from the Water: This done, we presently remov'd the Glass into a dark place, and pouring out the Water, we observ'd, that as soon as the Air came to touch the *Noctilucal* Matter, it seemed to be kindled into an actual flame, that afforded a very Vivid Light, which success pleased me the better, because it shewed, that a kind of Fire may be kept under Water, as long as one pleases, without sensibly

sibly burning, and yet in a moment,
 upon the bare removal of the Water,
 shew itself in the form of actual Fire.
 That our shining Substance was of this
 nature appeared manifestly by this,
 That the Water, being poured out
 somewhat too hastily, carried along
 with it, which I did not intend it
 should do, the whole Mass of the *Nocti-
 lucal* Matter, and This, by its fall into
 the Silver Cup, that was employ'd
 to receive the Liquor, was divided
 into two or three parts, which com-
 ing to a more free or full contact
 of the Air, blaz'd out much more
 than when they were in the Glass,
 and afforded us a delightful spectacle,
 since the flame burned upon the Wa-
 ter with much Light and fierceness,
 and a strange deal of Smoke, and it
 did ever and anon, sputter with noise,
 like Salt Petre made to burn upon a
 live Coal. These flames continued
 the pleasure we had to see them burn
 upon the water a pretty while, and
 after their extinction, looking into
 the Silver Cup, we found divers flakes
 of

of a Reddish Matter, (which the *Chymists* would call a *Caput Mortuum*) that lay at the bottom of the Water; and the sides of the Silver Cup, that were next to that Liquor looked almost as if fine Brick-dust had been strewed upon them.

Experiment II.

Being desirous to see whether, our *Noctilucal* Matter shining through a Coloured Glass, the Beams of Light would be ting'd in their passage, we took two or three Grains of our Matter, and put it into a Phial, of an almost Spherical Figure, capable of holding, by our estimate, about twelve Ounces of Water; which Phial was made of fine Glass, of a very pleasant Colour, participating of those that are call'd Orange and Aurora: But the Lucid Matter, being shut up in this Phial, and carried into a dark Room, did not appear through the Glass to be considerably altered in Colour; which because I imputed partly to the smalness

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of

of the Fragment of the *Phosphorus*, in reference to the capacity of the Vessel, through which it would give no more than a faint Light, I caused the Glass to be considerably heated, and then brought it into the dark Room, I staid for it in, there as soon as 'twas come, the included matter seem'd to be actually flaming, and the trajected Beams of Light appeared of an unusual and glorious Colour, the Light being so considerable, that it made divers Bodies distinctly visible, at a pretty distance from the Glass; and we judg'd that by the help of it a Book of a good Print might have been easily read; but this Light, which was the greatest we had, till then, produced with our *Phosphorus*, did not last long in its vigour, but in a short time gradually decay'd, till it came to little more than the usual splendor of the *Noctilucal* Matter.

Experiment III.

I formerly related, that I could not make such an Experiment, as I successfully

fully tryed with the Oyl of *Cinamon* and the Oyl of *Cloves*, to succeed with the Oyl of *Mace*. But now I must add, that the little Phial, wherein the *Noctilucal* Matter and that Oyl were included, having been set aside as useless, I afterwards chanced to cast my Eyes on it, and to have the curiosity to try, whether or no the unsuccessful Experiment I had made before, were not one of that kind, which in another Paper I have discoursed of, under the name of *Contingent ones*, and accordingly there being a somewhat dark corner in the Room, I carried the Phial thither, and although it were yet broad day, I unstopt it there, and was somewhat surpriz'd to find the included Matter to afford immediately a vigorous Light, which put me afterwards upon repeating the Experiment at different times, which I did with the like success, without being able to determine the cause of this odd *Phænomenon*.

Experiment IV.

One Experiment I shall now relate, which, though (because it seems, as well as the last recited, a contingent one; I forbore to set down with the rest) will perhaps be thought more singular than any of them.

We had in one of our Receivers, that was but small (since it was not judged capable of containing a Gallon of Water) a parcel of our Consistent *Noctiluca*, in which my Laborant told me, that he had met with a *Phænomenon*, that to him who knew nothing of what is related *Sect. XIV. Exper. I.* was very surprizing, and seemed to appear by chance, since he often tryed in vain, to produce it when he pleased. This Receiver I took into my custody, and pouring out the common Water, with which the splendid Matter was kept covered to hinder it from steaming away, we observed no other change, than that, upon the removal of the Water and the contact of

of the Air, the *Noctiluca* would immediately shine, and continue to do so, till we thought fit to extinguish it *pro tempore*, by pouring Water on it again.

This being done in the Morning, I considered the following Night, that this *Receiver* having been kept in the Laboratory, which constant and sometimes vehement Fires made a very warm place, 'twas but fit in order to make the Tryal a fair one, to bring the shining Matter to as great a warmth, as it had in the Laboratory, where it exhibited the *Phænomenon*, I was desirous to see. Having then caused the Receiver, with the Water in it, to be held in a hot place, till the Liquor had attained, by our guess, a fit degree of Tepidity, we poured out the Water, and within a minute or two after, by our estimate, we had the pleasure to see, that the consistent Matter, notwithstanding the wetness that in probability the Water had left on it, we observ'd I say, that This wet Matter, upon the contact of the
Air,

Air, took Fire of it self, not without noise, and burnt with a manifest and actual Flame. But our pleasure was somewhat moderated, though the Experiment was the more ascertained, by this accident: That, before we could pour in Water to quench the Fire, the violence of the flame had broken the Receiver, which was thick enough, and thrown off a piece above half as broad as the Palm of ones Hand, by which unlucky chance we were hindred from endeavouring to find, as we intended to do, whether we could by repeated Tryals discover the cause of the appearing contingency of this odd *Phænomenon*, which had far oftner in vain, than successfully, been endeavoured to be produced.

This Experiment recalls into my memory a notable *Phænomenon* belonging to that formerly recited (*Sect. XI. Exper. 2.*) about the kindling of our *Phosphorus* with the Sun-Beams, united by a burning Glass: For whereas, I there mention, that the *Noctilucal* Matter

Matter did not burn all away at first, but left a kind of *Caput Mortuum*, which lay in the form of a Cake variously coloured, I shall now add, that so much Matter could not be left unfired, unless something hindered its accension; we warily turned over the little Cake, with the point of a sharp Knife, and then the under part, being I presumed hot, presently took Fire upon the contact of the Air, and flamed away, till the Matter was almost totally consumed.

The Conclusion.

AND now I have acquainted you with all the chief things, that I have hitherto been able to try, or observe about our *Icy Noctiluca*, or solid *Phosphorus*: And though I have been oblig'd to deliver them without any exact Method, yet perhaps their novelty will serve to make them acceptable to you. Light is so noble a thing, that the matter, our *Phosphorus* affords it to reside in, being endued with

with some uncommon qualities, and particularly with a strange and almost incredible subtilty of parts, I cannot but hope, that, if improvements upon such a Matter were more industriously attempted, by persons better qualified for such a Work, than I (especially in my present Circumstances) pretend to be, something would be produced, tending to the discovery of the nature, not only of Light, but divers other Bodies, and perhaps also, of good use to humane life. If some unwelcome Circumstances did not for the present discourage me, I would contribute my weak endeavours towards such a design. For sometimes I think a Naturalists Pen, ought to be like a Merchants Ship, that comes from time to time into Port to rest, but not always to stay there, but to take in new Lading, and re-fit it self for a new Voyage to the same or other parts. In the mean time I recommend this Subject to your self, and those excellent *Virtuosi*, you hold Correspondence with, whose ingenious Attempts to advance true *Philosophy*, will have, for their good success, the hearty wishes of

Your most Affectionate, and
most Humble Servant,

R. B.

F I N I S.

A
**CHYMICAL
PARADOX,**

Grounded upon
NEW EXPERIMENTS,

Making it probable,

*That Chymical Principles are
Transmutable: So that,
out of One of Them, Others
may be Produc'd.*

By the Honourable
ROBERT BOYLE,
Fellow of the *Royal Society.*

L O N D O N,
Printed by *R. E.* for *B. Tooke*, at the
Ship in *St. Paul's Church-yard.*

168 $\frac{1}{2}$.

CHEMICAL
PARADOX

NEW EXPERIMENTS

These Chemical Principles are
Inconceivable: So that
out of One of Them, Others
may be Produced.

By the Honorable
ROBERT BOYLE
Fellow of the Royal Society

LONDON
Printed by R. E. for A. Took, at the
Sign in St. Pauls Church-yard.

A N
ADVERTISEMENT
OF THE
PUBLISHER
TO THE
READER.

THE Following P A-
RADOX having
been written in or be-
fore the Year 1680.
was kept in the Author's Hands,
that it might come out with the
Latin Version of his Treatise, in-
tituled, The Producibleness of
I 2 Chymical

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Chymical Principles, which is annexed to the Second Edition of His Sceptical Chymist, printed 1680. but some unluckie Accidents having kept that Translation from being finished, the Author thought fit the ensuing Paper should accompany his Icy Noctiluca, both in English and in Latin: Upon this account, he sent me not only the Discourse, that now comes forth, but some other Papers, containing the Minutes taken from time to time, by his Laborant, of what occur'd in the long Train of Distillations, on which the following Reflexions are grounded. For, the Reader, whether Forreign or Domestick, may here be pleased to be advertised, once for all, That as the Author hath been pleased
to

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to publish all his Works in the English Tongue, for Reasons best known to himself; so the Province of the Translating them into Latin, hath been undertaken by others: For, indeed, his Assiduity and diligent Attendance on his daily and growing Experiments, will not allow him leisure or opportunity to undertake that Work himself; tho otherwise if he had a desire to polish any thing in that Tongue, his Pen can command a fluent stile. This by the by. But I having returned to the Author both his own Papers, and my Version of them, in one Roll, it unfortunately hapned, that before the Icy Noctiluca was printed off, there broke out in the Night a great Fire not far from the Author's Lodging, which
was

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was so threatening, even after the blowing up of several Houses to stop it, that, as many others were obliged hastily to remove their Goods, our Author thought fit by the same way to endeavour to secure his own Manuscripts; but did it not so successfully, but that some are yet missing; and, among others, the English and Latin Papers lately mentioned. Notwithstanding which, the Importance of the Subject, and the Novelty of the Experiments, prevailed with the Author, (to prevent the like mischance from hapning to what he could retrieve concerning them) to communicate them to the Curious, who will, by what I have here related, be enabled to understand what he writes at the beginning of

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of that part of the following Paper, which, because it was written after the Fire above-mentioned, and very long after the rest, he calls his Postscript.

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A

CHYMICAL PARADOX.

I Adventured many years ago, in the *Sceptical Chymist*, and long after in other Papers, to lay down some Reasons of Questioning, *whether* the Fire be the true and proper Instrument of Analyzing mix'd Bodies, and do but *dissociate* their Principles or Ingredients, without *altering* them or *compounding* them anew. But I shall now present you a discovery, that will perhaps make you think the Vulgar opinion of Chymists to be less fit to be *doubted* of, than *rejected*. The occasion of making the following Experiments, was afforded me by the complaint of an ingenious Chymist, (and great Distiller) who told me, that endeavouring to purify an Essential Oyl by Rectification, he found
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to his disappointment, that he Distill'd it four or five times successively, yet it still left some Fæces, (but much less than at the first) though he concluded, that if he should undergoe the trouble of distilling the Liquor, a few times more, it would come over perfectly pure, without leaving any fæculency behind it. But 'twas more congruous to my *Hypothesis*, to conjecture, that the *Caput Mortuum* he complained of, was not, (at least after the first or second Distillation,) a more gross or *Fæculent part* of the Oyl, separated from the more pure; but a *new compound* produced, as other concretes also might be, by the operation of the Fire. This conjecture of mine was favoured by some Experiments, I had made many years before, and imparted to some inquisitive men, whereby two distill'd Liquors were made, barely by their mutual re-acti-
 ons, to afford great store of an Earthly and very fixed Substance. And to the same conjecture it was suitable, that by obstinately reitera-
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ring the Experiment, the action of the Fire upon the parts of the Body, exposed to it, and their mutual operations and combinations among themselves, and not improbably too, the material concurrence of Igneous particles, might produce, besides Earthly fæces, other Bodies not unlike *those* that pass for the Chymists Principles. How far the event proved agreeable to his *Hypothesis*, will be best gathered from the *Phænomena* themselves, of the Tryals, which I shall proceed to set down a succinct account of, as soon as I have premised, to make way for it, That by an Essential Oyl, Chymists are wont to mean such a fine Oleagenous Liquor, as to prevent Emphyreume and fæculent parts, has been distill'd with store of Water in a (*Vesica* or) Limbeck.

We took a pound of Essential Oyl of Anniseeds, which Liquor (we therefore made choice of, because 'tis more easie to discern it, by its self-coagulating property, not to be sophisticated; and having put it into a Glass Retort
of

of a convenient size, we caused it to be Distill'd, (in a Sand Furnace, capable of giving a strong Fire) thirty six times, in which train of Operations, the ensuing *Phænomena* were both congruous to our *Hypothesis*, and in themselves observable.

1. As pure as the Essential, or, as some *Spagyrist*s stile them, the *Ætheri*-al Oyls of Vegetables are presum'd to be, and as confidently as Chymists pretend they are, the pure Sulphurs or Unctuous principles of the Bodies that afford them; yet, not only the first distillation left a Substance Black, like Pitch, at the bottom of the Retort, but, at every one of the following Distillations, such a Substance was either separated or generated.

2. Though after a Distillation or two it seem'd likely, that this Pitchy Substance would be found every time less and less, which made the person, formerly mentioned, tell me, that he suppos'd within ten or at most twelve Distillations, in all, if one should make so many, this which he lookt upon as
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an Earthy recrement would be quite separated, and leave the Oyl a most pure and Homogeneous Liquor; yet I that (as I formerly intimated) look'd upon this black stuff not as a separated Excrement, but generated Substance, caused the Distillations to be repeated till they had attained thrice that number, and not only found that at each time, such a black Substance was left; but that now and then a subsequent Distillation yielded much more of *it* than the precedent had done; which change, from less to more, and from more to less, was not observed only once or twice, but several times. And though this odd Pitchy Substance were towards the latter end found in less quantity, than at the beginning, yet the cause of that may well be, that the Oyl to be Distill'd did sensibly from time to time decrease in Bulk, partly by reason of the recess of that portion of the Oyl, which could not but be dissipated and lost in so many Cohobations; and partly, and indeed chiefly, by the loss of so
much

much Oyl as was transmuted into Pitch and other Substances.

3. The Oyl appeared in Distillation more fixed or unapt to rise than one would have expected from so fine and light a Liquor, and especially towards the latter end of the Distillations, it was often necessary to employ a scarce credible degree of Fire to elevate all, that was not turned into Pitch.

4. The Liquor did not Distill like a pure Principle or Homogeneous Body, as Quicksilver is wont to do, but first some fine and light Oyl usually came over, after which followed a less volatile Oyl with another Substance or two, and after that, another ascended in a distinct manner.

5. For 'tis to be noted that besides the forementioned black Earth, there were produced by the operation of the Fire divers other Substances, whereof the first was a Waterish Liquor or Phlegm; which, after the Oyl had been exposed to some Distillations, began to grow very troublesome.

troublesome. For being rarified by the heat of the Fire into large bubbles, the Antipathy, or rather Incongruity, between them and the Oyl, occasioned a kind of conflict, wherein these Bubbles did often suddenly break, (usually not without much noise) and sometimes with such violence, as to shake and endanger the Retort; which once, by this contest, was actually broken; yet not so, but that the Liquors and other products of the Fire were saved by the watchful Laborant, and seasonably transferred into a new Retort.

6. Besides this Phlegm, and the Pitch formerly taken notice of, our operation afforded us from time to time a pretty quantity of a certain Substance, which, with some not unskilful Persons, passed for a Volatile Salt; because it ascended to the upper part of the Vessel, and appeared in a dry form, almost like short Needles; and because also, it seemed to the Laborant, that, like a Salt, it was (part of it at least) dissoluble in the Spiri-

Spirituos Phlegm, mentioned in the last Number. But though at first, I inclined to this Opinion, yet having made some few Tryals to examin the truth of it, I was, and still am, a little doubtful, whether this sublim'd Body deserve the name of a true Volatile Salt, though possibly there may be a pretty deal of *that* contain'd in it. For I found the lumps of it, notwithstanding their seeming Sponginess, to sink in common Water, and continue at the bottom of it without manifestly being dissolv'd by that Liquor, (as meer Volatile Salts are wont easily to be) either in the Cold, or by being kept a while in a moderate heat. I found this Substance fusible, like Bees-wax, at the flame of a small Taper, and if a lump of it were kindled thereat, it would burn away, partly with a Yellow flame, and partly with a flame more intensely Blue, than *That* of rectified Spirit of Wine, but it appeared apt enough to go out of it self.

These

These, and some other things inclin'd me to look upon our anomalous Sublimate, as a Substance, *sui generis*; but yet such a one, as I suspected to be somewhat of kin to a *Sal Volatile Oleosum*, such as *Camphire* seems to be. For our Sublimate rises without strong Fire, and that in a dry form, and is easily enough fusible; all which I have observed in *Camphire*, as well as in Volatile Salts, and our Sublimate will, like *Camphire*, dissolve in a high rectified Vinous Spirit without at all Colouring the Liquor. And having long since found by tryal, that *Camphire* will, though slowly, dissolve in good Oyl of *Vitriol*, and make the Menstruum look of a Reddish Brown; I put some of that solvent upon our Sublimate, and after having left them some hours together, though but in the Cold, the Liquor seemed to have dissolved part of the dry Body, having, by its action upon it, acquired a Brown Colour somewhat inclining to Red; and part of this Liquor

K being

being put into a pretty deal of common Water, there seemed to Emerge by degrees a dry Body, or *Flores*, which brought into my mind, what I have elsewhere observed, when I employ'd the same method, to recover *Camphire* out of Oyl of *Vitriol*. But, as I was lately intimating, though I think it not improbable, that our *Anomalous Sublimate* may be nearer of kin to a *Sal Volatile Oleosum*, than to any of the Chymical Principles; yet I have not hitherto found the resemblance betwixt *it* and such a Salt, to be compleat enough to make me *Dogmatical* in referring it to any *Chymical Product*, of a known denomination: And therefore, till I be further satisfied, I shall only add, that this Volatile Salt, or Oily Sublimate, or whatever name it may deserve, was very pretty to look upon, being glittering almost like some fine flowers of *Benzoin*; and of this we had, though it were very light, between two or three Drams.

7. Besides all these differing Substances, our Oyl of *Anniseeds* afforded

ed us from time to time, a little quantity of *Spirit*, as we concluded from two or three Signs: *One*, that it came not over with the Phlegm, and yet would mingle with that Liquor, but not with the Distill'd Oyl: And *another*, that, as it was more fixed than the Oyl and Phlegm, so it rose latter than they; and not only needed a stronger degree of Fire; but, which is chiefly considerable, it was usually observed, to come over in white fumes, as many Spirits, that are somewhat fixed, are wont to do; which was the more easy to be observed, because, that being willing to make use of the same Retort as long as we could, for the greater certainty of the Experiment, and the Pitch being not to be taken out, whilst 'twas any thing soft, because of its close sticking to the Glass, it was thought, to give at the latter end of the Distillation, so strong a Fire, as, by making the Sand and Retort red hot (or very little less hot) would make the Pitch so dry and brittle, that it might afterwards be loosened from

the sides of the Glass, and got out in the form of a dry and brittle, though exceeding Black Substance. And to the *two* foregoing signs I shall now add a *third*, that does more clearly evince, that the Substance we have been speaking of, was a Spirit: For, though it could not but be very much weakned by being diffused through so great a quantity of Phlegm, as came over before it, yet its Corpuscles were so many and vigorous, that when I put them upon the powder of *crude Coral*, they presently began to dissolve it, and the *Phlegmatick Spirit* did in a trice make a great *Ebullition* with noise and bubbles, whether I poured it on the fix'd Salt of *Tartar*, or the Urinous and Volatile Salt of *Sal Armoniack*.

The success of this Experiment, being answerable enough to what I desired and expected from it, allow'd me to make divers reflections on it, and particularly those that follow.

And, 1. Our Tryal argues, that a Substance, that is looked upon by Chymists

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Chymists as a homogeneous Body, and which passes for one of their Principles, (for that is the case of our Essential Oyl of *Anni-seeds*) may yet be of such a nature, that barely by the further action of the Fire, it may be made to afford a very considerable proportion of a Substance exceedingly different from that which afforded it. For in our Experiment, we obtained a *Caput Mortuum*, whose qualities were quite other, than *those* of Oyl of *Anni-seeds*; since it was opacous, black, dry, very difficultly fusible, and fixt, in so strong a degree of Fire, as made the Retort that contained it, and the Sand about it red hot. This Substance would lye undissolved in a highly Rectified Vinous Spirit, into which Oyl of *Anni-seeds* would readily have diffused it self (if they had been a litte shaken together) without the help of heat. And though we made the Liquor actually boyle a pretty while, yet most of the *Caput Mortuum* continued a black Substance, only it dis-

coloured the Menstruum, which lookt as if it had rather extracted a Tincture, than made a solution properly so called. And of this black and Pitch-like *Caput Mortuum*, we had at the end of our Distillations, when we weighed the several parcels altogether, not much less (which you may justly think strange) than half the weight of the whole Oyl of *Aniseeds*; this black stuff amounting to a pretty deal more than seven Ounces. And from hence we may collect, that the *Analysis*, wont to be acquiesced in by vulgar Chymists; is as yet, but an indetermin'd thing, since they have not declared (nor perhaps thought of any such thing) what number of Distillations, (whether one or more, or if more then one, how many,) shall be made the standard, by which we are to conclude, that a Substance, obtained by Distillation, is a Chymical Principle.

2. It may be also inferred from some *Phænomena* of our Experiment, that the Fire, as 'tis wont to be employ'd, is not, as Chymists pretend it
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to be, the true and genuine Instru-
ment of the *Analysis* of Bodies, since it
does not, as they presume it does, bare-
ly extricate and separate the several
similar Substances, that, though con-
cealed and disguised by commixtures
with each other, were pre-existent
(in the same forms wherein they
afterwards appear) in the Body ex-
posed to its operation. For in our
case the Oyl of *Anniseeds* is, according
to the Chymists estimate, the *Sulphu-
reous Principle* of the Concrete; and
therefore has not any other Princi-
ples, especially in any considerable
quantity, contained in it. And yet,
by the bare action of the Fire, this
Oyl, which they acknowledge to be
a similar Body, is brought to afford
three or four other Substances, of diffe-
ring natures from one another.

3. From the two foregoing Obser-
vations we may likewise deduce,
That the Fire, at least in divers cases,
may not only *separate*, but variously
compound and *alter*, the parts of a
Body exposed to its action; and there-

by give considering men cause to suspect, that divers Substances, that are presumed to be only *Extricated* or *Extracted* by the operation of the Fire, may be really produced by it.

4. Agreeably to which suspicion, it happens unluckily enough for the Chymical *Hypothesis*; that in our Experiment, the Substances that were obtained, were, a fixt and Earthy Powder, a not inconsiderable portion of Phlegm, a Spirituous Liquor, and a dry Sublimate, a-kin to a *Volatile Salt*: And these, though they all proceed from a Body, that, according to the Chymists *should* not, and indeed, for ought appears, *did* not actually contain any of them before, did yet so resemble in qualities the Earths, Phlegm, and Spirit, that Chymists obtain by Distillation from those Bodies, they look upon as perfectly mixed and compounded, that if they are not the same, they have divers qualities, so like *those*, that entitle what is afforded by confessedly mix'd Bodies to the name of Phlegm or Salt,
or

or some other Primordial Ingredient, that the Earth for instance, or the (*acid*) Spirit obtain'd in our Experiment, are far less differing from the Earth of Blood, or the Spirit of *Amber*, than these are from the Earth and Salt of thoroughly Calcined *Hartshorn*.

5. 'Twill scarce be necessary to draw so obvious a Corollary from what has been already deliverd, as this; That 'tis possible, that Chymical Principles (or at least such Substances, as a Vulgar Chymist, not knowing from what Body they were obtain'd, would look upon, as such) may be made of another.

But though I shall not enlarge on this *Corollary*, it will not be amiss to make one considerable Observation, that belongs to it. Namely, that *Acid* and *Aqueous* Substances, how differing soever each of them is from a pure Oyl, may be produced from it, by the action of the Fire. For I found by Tryal, that in that Liquor which the Laborant took for the
Phlegm

Phlegm of Oyl of *Anniseeds*, there was such store of Acid parts, that (as was above recited) they would readily dissolve powdered *Coral*, though crude, even in the cold; and would make a great conflict with Salt of *Tartar*, and with that of *Urine*, as soon as the Liquor was put upon it. But yet the greatest part of the Liquor by far, seemed to be of an Aqueous nature, which a Chymist would call Phlegm; which is a Body that will not mingle with Oyl, and is otherwise exceedingly different from Oyl, especially an Essential one, (such of that of *Anniseeds*,) whose purity makes it it totally inflammable. And the quantity of the whole Liquor, consisting of Acid and Phlegmatick parts, was far from being inconsiderable, amounting to about two Ounces and three quarters. It may also be worth while to observe, as another thing belonging to our *Corollary*, that the Truth, declared in it, allows us to question, whether it be necessary to suppose with
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the Chymists, that Nature has been oblig'd to make provision of great quantities of *Primordial* and *Simple* Bodies, and that she is solicitous to mix them all together, for the composing of a Body, capable of affording by the *Analysis* or separatory Operation of the Fire, Salt, Spirit, Sulphur, Phlegm and Earth: I will not hence universally infer, that there are no such Substances, one or more to be found, in any of those Bodies that are called perfectly mixed, antecedently to their being exposed to the Fire. But this, I think, will follow from what has been delivered, that the pre-existence of such Substances must be made out by some other way, than the bare operation of the Fire; and that the grand Chymical supposition will not hold in all Bodies, that *what similar Body soever is obtain'd by the operation of the Fire from a Concrete, committed to Distillation, was formerly and actually pre-existent in it.*

6. And lastly, our Experiment affords us a considerable Argument in
favour

favour of that part of the Corpuscular, or Mechanical *Hypothesis*, that teaches, inanimate Bodies to differ from one another, but in the bigness, shape, motion, contexture, and in a word, the Mechanical affections, of the minute parts they consist of. For in our Experiment, we see that Oyl of *Aniseeds*, which is not only an uniform or similar Body, as to sense, but is judged *so* by Chymists, upon an *Analysis* of the concrete that afforded it, is, by having its parts variously agitated, shak'd, and rubbed against one another, and in differing manners broken, associated, and ranged, transmuted into four Bodies of such differing natures and qualities, as the Chymists principles and Elements are known to be. And this without the help of any true Seed or plastick Principle, by the bare operation of the Fire, which *Helmont* calls *the Artificial death of things*, and *the destroyer of Seminalities*. And this is the more considerable, because, whereas the Ancient

Corpus-

Corpuscularian Philosophers assigned three general ways whereby Bodies may be produced; namely, by the *addition* of new parts, the *dividing*, and sometimes *taking away* a portion of the former, and the *Transposition* of the constituent parts, in our Experiment, the whole work seems to be performed only by what they would have called *Transposition*, and that guided but by so simple, impetuous, and unruly an Agent, as the Fire. Unless it be said, that divers igneous particles, that penetrated the Glass Retort, did substantially associate themselves with some parts of the Oyl of *Anniseeds*, and concur with them to compose the Pitch-like *Caput Mortuum*; which they will perhaps say, that (whatever others may do) I ought to allow as a possible thing; after what I have elsewhere written, purposely to shew, that such a penetration of the Pores of Glass, by the Atoms of Fire is not impossible. But the Experiment, I have delivered, of the Ponderability of Flame, prove only that

that some of its Particles may combine with heavy Bodies, and fix'd in the degree of Fire I expos'd them to; my Tryals having been made upon Tin and Lead. And it will not perhaps be thought likely, that Ignitious Atoms should, by their combination with the Particles of an inflammable Oyl, produce an Aqueous Liquor, and that in great quantity; as we lately noted of the *Acid Phlegm* of *Anniseeds*, amounting to two ounces and almost six Drams.

Upon the whole Matter, the *Phænomena*, observable in our Experiment upon Oyl of *Anniseeds*, seem very congruous to the Mechanical *Hypothesis*, and very unfavourable to *That* of the Chymists. For, whether the Fire be supposed to have Acted merely as an Agent, or Efficient Cause, or to have also concurred as a Material one; it appears, that by changes of Texture, without the Addition of any visible Parts, or of any Seed, Bodies very differing in Colour, Consistence, Fixity, and divers other Qualities,

Qualities, may be produced from a Body, not only homogeneous, as to sense, but pure enough to pass for a Chymical Principle. And, though the suspicion lately proposed, should be allowed to be Probable, as to the other Products, as well as to the black Substance; yet still our Process upon the Oyl of *Aniseeds* would afford considerable Corollaries against the Chymical Doctrine, I call in question. For, 1. The Objection we are considering, will give wary men just ground to suspect, that in ordinary Chymical Distillations the Fire is not always to be looked upon as a meer Instrument of *Analysis*; but may in many, if not in most cases, be also a material Cause of the supposed Principles, produced by its means; which is quite contrary to the Received Doctrine of the Vulgar Spagyrist, (who are those, I now dispute with.) But, not to insist on this Remark, I think our process upon Oyl of *Aniseeds*, will not serve to prove the Paradox proposed at the beginning of this Paper;

Paper ; since, treating of Ingredients Chymically obtainable, I may be allowed to speak of them in the usual sense of Chymists, who suppose the different Substances, obtained from a Body committed to Distillation, to be the *Hypostatical* Principles, and other Ingredients of it, without supposing the Fire to do any more than extricate or disentangle them from one another. So that, *Secondly*, (to conclude at last this long Paragraph) our Experiment seems to prove the Production of *other* Chymical Principles out of *one*, as validly as *their* Experiments prove, that such Principles are obtained from the Bodies, they call Mix'd. For, whereas the force of the lately proposed surmise or objection, lies in this, that the Association of Igneous Particles hinders the different Substances, that our Oyl of *Anniseeds* afforded us, from being uncompoundd Bodies, and therefore from being true Principles, they may for all this have as good right to the Title of Principles, as most of these
they

they will have us take for such: Since the Atoms of the Fire, may every whit as reasonably be supposed, to Associate themselves variously with the Corpuscles of a Mixt Body, committed to Distillation, as with those of Oyl of *Anniseeds*, and so their supposed Principles will, no more than ours, be free from Composition. Nay the advantage in the Comparison, lyes on our side, since the different Substances, that Chymists are wont to obtain from a mixt Body, may be Compounded, not only with Igneous Particles, but with the differing Ingredients of the same Body; since this in their *Hypothesis* is a mixt Body; whereas Essential Oyl of *Anniseeds* is by them granted to be a Simple one: And therefore each of its Productions, is compounded with no Extraneous Substance, save the Corpuscles of the Fire.

When I had framed the Conjecture,
That from a Chymical Principle, several differing Bodies might be obtained
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by the meer operation of the Fire; I thought fit to endeavour the Confirmation of it, by making Experiments upon other Distill'd Oyles, (for those made by expression, are by Chymists themselves, own'd to be Compounded Bodies,) of Natures different, both from the Oyl of *Anni-seeds*, and from one another. And accordingly, whilst our Process with this Oyl, which the Chymists call Essential, and which was drawn from a Vegetable Seed, was carrying on, I took care to have Distill'd in the same Furnace, *Oyl of Turpentine*; which, though drawn from a Vegetable Substance differs, very much from Oyl of *Anniseeds*, as also *Oyl of Amber*; which, according to Chymists, belongs to the Mineral Kingdom; And lastly, *Oyl of Harts-horn*, afforded by a Subject, which (to speak in their Phrase) belongs to the Animal Kingdom.

POST.

POST-SCRIPT.

THese Oyls were committed to the same Laborant, that managed the lately mentioned Oyl of *Anniseeds*; and he accordingly kept a kind of Journal of the number of Rectifications, the Quantities of Pitchy Matter from time to time afforded by them, and divers other *Phænomena*, or Circumstances, that occur'd in so tedious a Prosecution, as I thought Experiments of such moment deserved. But, the Papers, containing the Minutes of these things, having been unhappily lost, with divers others, by occasion of a great Fire, that obliged me after midnight to make a hasty and very disorderly remove of my Writings, I could never once retrieve the Particulars. And therefore I must content my self, to set down as much of the Tryals

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(which I hope will comprize the most substantial part of them) as by examining my own Memory and the Laborants, and by some few other helps, I am able to collect: As soon as I have given here one Advertisement, because I think it was omitted, in the Papers, whence the foregoing part of this writing, was Transcribed. The Advertisement is this: that as well in the precedent, as in the subsequent part of this Discourse, I do not take *Chymical Principles* in the strictest sense of that Term wherein it is confin'd to Salt, Sulphur, and Mercury; but in the larger acception, wherein the Learned Doctor *Willis*, and divers other Chymists (that are not all his Juniors imploy it, when they comprize under it, two Elementary Bodies; they do when they constitute five Principles, (which perhaps might be more clearly call'd *Similar Ingredients*;) in which number they comprize Phlegm and Earth, which other Chymists, as well as the *Aristotelians*

would call Elements, (of the Body that affords them.) Taking then in this whole Writing, the word *Principles* in the larger sense above declared (congruously whereunto I usually call them the *Chymical Principles* indefinitely, not the *Hypostatical Principles*, which are accounted but three;) I proceed to the particular Observations and Reflections I was going to begin.

First, Then it plainly appears, that two of the three lately mentioned Oyls, namely, the Oyl of *Turpentine*, and the Oyl of *Amber*, and therefore very probably the third also, (my design being the same in all three) were Distill'd at least fifty times; for I intended not to stop short of that number. And by an Inscription upon one of the Phials, I found that the Oyl, which the contain'd Liquor was drawn from, had been Distill'd one and fifty times: which number exceeds by fifteen, *that* of the Distillations formerly mentioned to have

been made of the Oyl of *Anni-seeds*.

2. Each of the three other Oyles, (*viz.* that of *Harts-horn*, that of *Turpentine*, and that of *Amber*,) did leave from time to time, in the bottom of the Retorts, whence they were drawn off, a not inconsiderable quantity of Black Fæces, much like those, that were left by the Oyl of *Anni-seeds*, and which I have formerly call'd a Pitchy Substance: I found in a Superfcrib'd Paper, some quantity of this stuff left by the Oyl of *Turpentine*, and, though I am not certain, whether it were all the stuff of this kind that was afforded by the pound of Oyl we employed, yet it amounted to above two Ounces and five Drams: And if I much mistake not, the other two Oyls did each of them afford a considerable quantity of Black Terrestrial Matter, though the heedful Laborant observed, that the Oyl of *Harts-horn* did sooner leave off yielding copious Fæces (as I often in this Paper call them, to comply with

with the Chymists Terms, though I assent not to their Notion) than the Oyl of *Turpentine*, or that of *Amber*. But if neither of the two afforded any more, than did the Oyl of *Turpentine*, I look upon it as a remarkable thing, that the Oyl of *Aniseeds*, which is a fine Essential Oyl, Distill'd in a Vesica or Limbeck, should yield above twice more of Earthy Matter, than either of the three other Oyles, that were Distill'd but in Retorts.

3. Of the Colour of the Rectified Oyl of *Harts-horn* I can say little, having unluckily lost the Liquor it self; but the Oyl of *Amber*, after the one and fiftieth Distillation, was indeed very clear, but yet of an *Amber* Colour, that was far from pale. And the Oyl of *Turpentine*, that is usually after one Rectification a clear and Colourless Liquor, after fifty Distillations, appeared almost Red.

4. But

4. But *that* is much more considerable, which I observed in the quantities of the different Liquors, afforded by the long series of our Distillations, for at the end of the process, the remaining Oyl of *Turpentine*, for instance, did not appear to my Eyes to be considerably, if at all, Superiour in bulk to another Liquor, that came over with it in Distillation, and was not true Oyl, for it would readily enough mix with Water, but keep it self in a Mass distinct from the Oyl, and weighed above three Ounces and three quarters.

5. This oddly produc'd Liquor, I looked upon as compounded of Spirit and of Phlegm: For though the latter did so much exceed the other in quantity, that in an expert Chymists Opinion, the whole Liquor passed for Phlegm; yet, I not only judged some parts of it to be Spirits, but found them to be of an *Acid* nature too; since, besides what the taste made
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me suspect, I found that the Compounded Liquor would readily enough begin to Corrode beaten *Coral*, even in the cold, and some of it being poured upon good Salt of *Tartar*, presently made with it a Conflict and Ebullition, not without a hissing noise and a multitude of Bubbles. So likewise the Spirituous Phlegm of *Amber* made a conflict with Salt of Tartar, and dissolved crude Coral, as other weak *Acid* Spirits are also wont to do. This Liquor of *Amber* was not pale, as the Phlegmatick Spirit of Oyl of *Anni-seeds*, was; and *that* lately mentioned to have been obtained from Oyl of *Turpentine* was high Coloured, being of a brownish Red.

6. I forgot to take notice in due place (and therefore do it in this) that, among other Tryals made to discover, that the Spirits afforded by our Oyls were really Acid, we put two ounces of the Spirituous Phlegm of Oyl of *Anni-seeds* (that being the mildest

mildest Oyl) upon some *Minium*; and, having digested them a while together, found the Liquor turn'd sweet, and fit (as we judg'd) to make *Saccharum Saturni*: And this Liquor (after Filtration through Cap-paper) being gently abstracted, left in the bottom of the Retort, a thick Honey-like Substance, from which (the Distillation being continued in the same Retort, but with a much stronger heat) there came over some Liquor, which being in too little quantity to be Rectified, we could not free it from its Phlegm, and therefore did not find it Inflammable; as I guessed the Spirituous part would have been after Rectification, in regard the Liquor was exceeding like the *Spiritus Ardens Saturni*, I have elsewhere described in its peculiar, and very penetrating taste and smell.

7. It may not be unfit to be taken notice of in this place, that, having lighted on two Phials, that I long

long knew not what was become of, one of which contained some of the Oyl of *Turpentine*, and the other some of the Oyl of *Amber*, that I formerly mentioned to have been each of them Distill'd at least 50 times; I thought fit to try, whether after these Liquors had been laid by about a year and half, or longer, they, would after having had so long a time to defecate themselves in, yield still such a black Substance, as has been oftentimes mentioned; and having, to satisfy my self, caused each of these Liquors to be again Distill'd in a Retort, it left behind it a greater quantity of a black and shining Substance, than could well have been expected.

8. It may seem very odd in it self, and may much serve to confirm, what I have elsewhere delivered about the Mechanical Origin of Fixity, as also of the Qualities opposite to Fusibleness and to Fluidity; that, so Volatile and thin a Liquor, as a Chymical

mical and Rectified Oyl, should by the bare operation of the Fire, be brought to yield a great quantity of what looks so like Terrestrial fæces, as our Pitchy *Capita Mortua* did. But this reflection will, I presume, appear the better grounded, if I add the success of one Tryal (among others) that I made, to examine the Terrestrial Nature of the black Bodies, I am speaking of: For, although many Bodies that will not ascend, or be dissipated in close Vessels, will easily be driven away in open ones; yet having put one ounce of the *Caput Mortuum* of the Oyl of *Anni-seeds*, and as much of *that* afforded by Oyl of *Turpentine*, each of them into a distinct Crucible, and kept them three hours and a half, or near four hours, in such a heat, as made the Vessels all the while red hot; though we kept not the Crucibles closely covered, but only loosely to keep out the Ashes, yet we found, when the Vessels were removed from the Fire, that the contain'd Bodies had

had not at all been brought to fusion, only *that* from the Oyl of *Aniseeds* was in part somewhat caked together: And notwithstanding, all the heat, they had been exposed to, the Pitchy Substance of the Oyl of *Turpentine*, retain'd not far from three quarters of its first weight; and the *Caput Mortuum* of Oyl of *Aniseeds* lost about eighteen grains less than *that*.

9. After this we also endeavour'd to discover, whether our Pitchy Substances would afford any Fixt or Alcalisate Salt, as the *Capita Mortua* of most Bodies belonging to the Vegetable Kingdom, are wont to do. But *though* we kept an Ounce a-piece of the black Substances, left by the Oyl of *Aniseeds* and that of *Turpentine*, for nine or ten hours, red hot in the Crucibles; yet we found indeed the Bodies very much diminished in quantity, but they did not appear at all Calcin'd.

10. Into a couple of Ounces of this last named Liquor, we put by
little

little and little, of much of dry Salt of *Tartar* as it would work upon, as an *Acid*, or (if you please) till there would no longer be any visible conflict excited by adding more Salt. The Acid being thus mortified or fatiated, I intended to draw off all the rest of the Liquor, and to try with the Phlegm drawn off, whether by cohobating it very slowly in a new Glass-head and Body, I could not make a farther transmutation of the Terebinthinate Oyl, and change, at least, part of this Aqueous Phlegmatick Liquor into a whitish Earth. About the possibility of which Transmutation, and of some others also, I might here subjoyn an account, if, since the lately mentioned Fire, I could have found a short discourse, I wrote, to propose and examine this grand Physico-chymical Probleme, *Whether we ought to admit any other Elements or Hypostatical Principles at all, even so much as one of the Bodies that are commonly called, mixt?*

F I N I S.

E R R A T A.

THE first *Advertisement*, page 5. line 18. dele
very. p. 22. l. 5. read *Immersed*. p. 34. l. 5. r.
Spe-ctators. p. 40. l. 16. r. *Operation*. p. 125. l. 22. r.
Little.

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