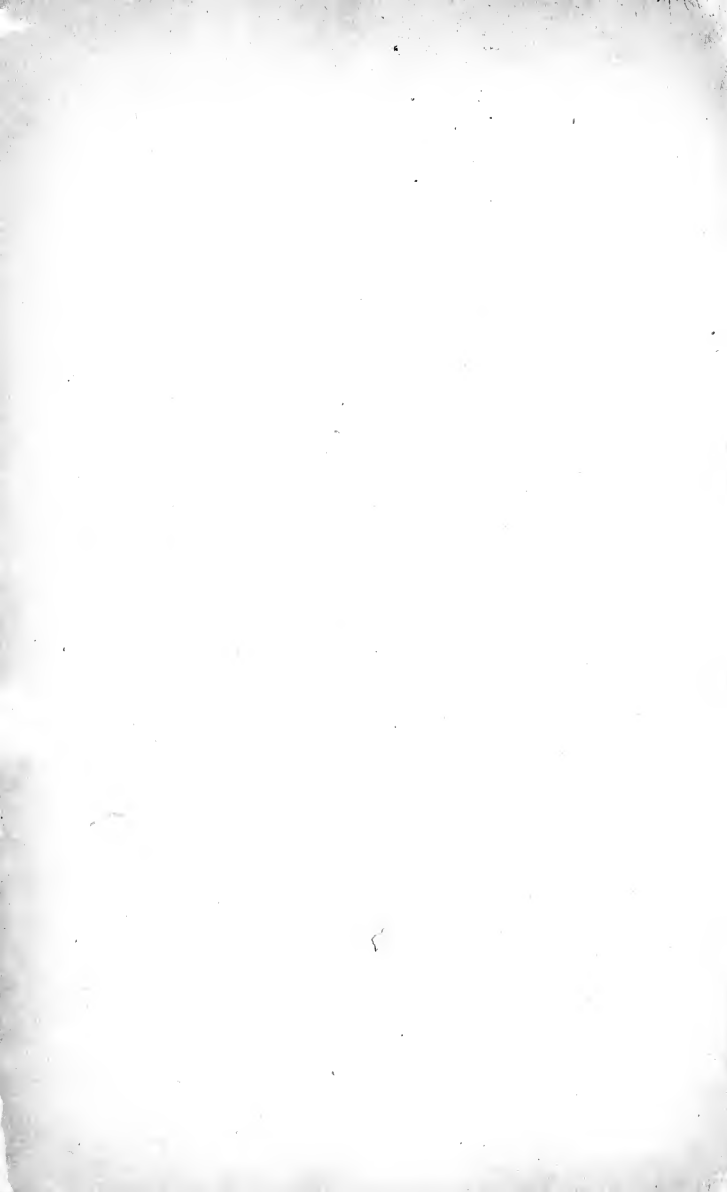
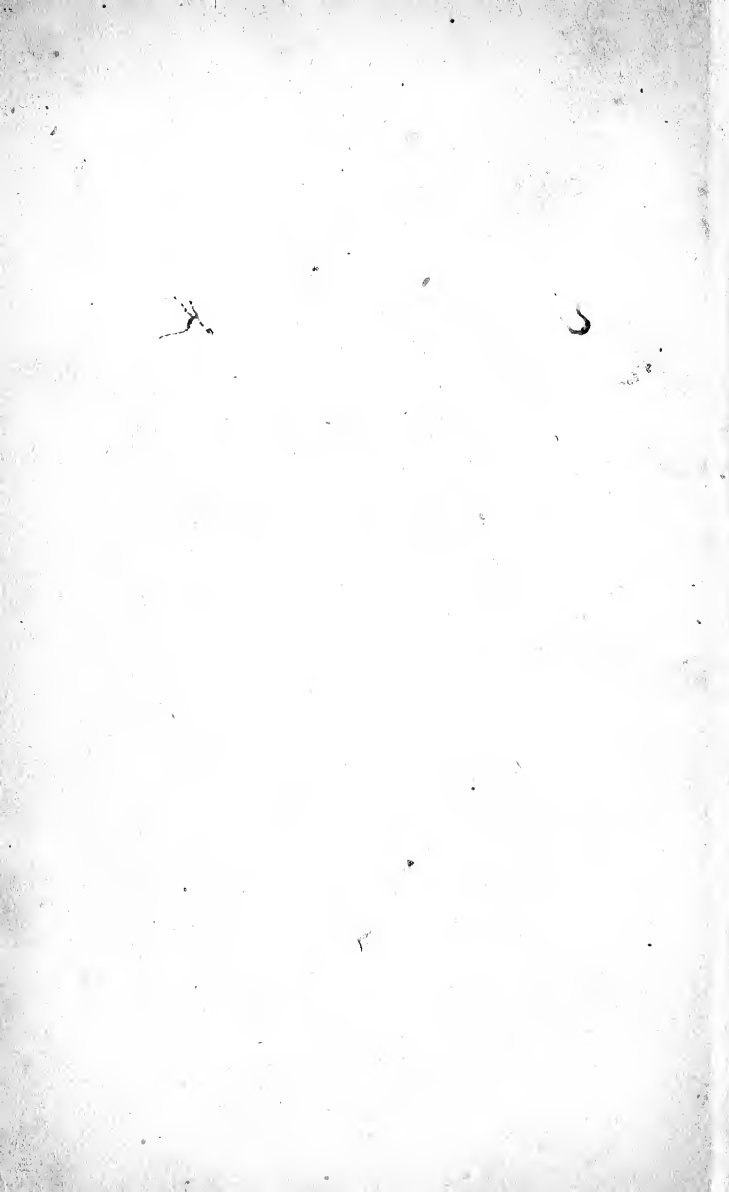


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THE
PRODROMUS

TO A
DISSERTATION

Concerning
SOLIDS Naturally Con-
tained within SOLIDS.

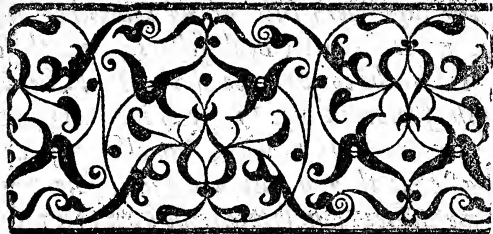
Laying a Foundation for the Ren-
dering a Rational Accompt both of
the *Frame* and the several *Changes* of
the Masse of the EARTH, as also
of the various *Productions* in the same.

By NICOLAUS STENO.

English'd by H. O.

L O N D O N,
Printed by *F. Winter*, and are to be Sold
by *Moses Pitt* at the *White-Hart* in
Little Brittain, 1671.





THE
INTERPRETER
TO THE
READER.

READER,

THis Ingenious Piece, lately publish'd
in Italy, (where 'twas Printed in
Latin,) and thence come to the
hands of the Interpreter, was thought fit to
be English'd, chiefly upon this occasion, That
the Stationer, that hath Printed it, did, upon
Information given Him, of the Valuable
Contents thereof, earnestly sollicite, that
it might forth-with be put into this Lan-
guage; he not only conceiving, that there
being

To the Reader.

being now very little or no commerce between the English Book-sellers, and those of Italy, the conveyance of this Book, (as it doth of others there Printed) into England would prove very tardy; but also considering, that though within a reasonable time some Copies of it should come over, yet there would not be enough of them, to serve all sorts of curious English-Men, nor even that number of English Readers versed in the Latin Tongue, which this Considerable Discourse is like to meet with, forasmuch as it giveth very fair hopes, That by a due weighing of the particulars, therein laid down, the sagacious Inquirers into Nature may be much assisted to penetrate into the true knowledge of one of the Great Masses of the World, the *EARTH*, and therein to find out not only the Constitution of the Whole, but also the several Changes, and the various Productions made in the Parts thereof; as the Excellent Robert Boyle hath of late Years, with great Acuteness as well as unwearied Industry, led us on a great way in the knowledge of another of the great Masses, the *AIR*; though the same also hath not been unmindful of considering this very subject, here treated of; forasmuch as

He,

To the Reader.

He, before he would see or hear any thing of this Prodrumus, did upon occasion candidly declare to the Author of this Version, (who bona fide here publickly attests it,) 3

First, That he doth, upon several inducements, suppose, the generality of Transparent Gems or Precious Stones to have been once Liquid Substances, and many of them, whilst they were either fluid, or at least soft, to have been imbraced with Mineral Tinctures, that con-coagulated with them; whence he conceiveth, that divers of the real qualities and vertues of Gems (for he doubts, most ascribed to them are fabulous) may be probably derived. And as for Opacous Gems and other Medical Stones, as Bloud-Stones, Jaspers, Magnets, Emery, &c. He esteems them to have, for the most part, been Earth (perhaps in some Cases very much diluted and soft,) impregnated with the more copious proportion of fine Metallin or other Mineral Juices or Particles; all which were afterwards reduced into the forme of Stone by the supervenience (or the exalted action) of some already in-existent petrescent liquor or petrifick Spirit, which he supposeth may sometimes

To the Reader.

times ascend in the forme of Steams; from whence may be probably deduced not only divers of the Medical Vertues of such Stones, but some of their other Qualities, as Colour, Weight, &c. and also explained, How it may happen what He hath (and, he doubts not, others may have also) observed of Stones of another kind, or Marcasites, or even Vegetable and perhaps Animal Substances, that have been found inclosed in solid Stones: For, these Substances may easily be conceived to have been lodged in the Earth, whilst it was but Mineral Earth or Mud; and afterwards to have been, as

* Of these Pretious Stones this Noble Philosopher was

pleased to leave with the Publisher a Manuscript of his composure, now ready to be Printed, which he assur'd him it had been several Years ago.

Nor are these Petrescent liquors the only ones, to which he supposeth that many Fossils may owe their Origin, since he thinks, there may be, (if one may so speak) both Metallescent and Mineralescent Juyces in the bowels of the Earth, and that sometimes they

To the Reader.

they may there exist and operate under the forme of Spirits or Steams. *

* About which he also was willing not only to shew

to the Publisher several Observations and Collections of his in the forme of *Discourses*, but also to put them into his hands to peruse the same.

Besides this, we cannot but take notice here of what was intimated a good while ago in *Numb. 32.* of the *Phil. Transactions*, p. 628. viz. That Mr. Robert Hook had at that time ready some Discourses upon this very Argument, which, by reason of the many avocations he hath met with in the rebuilding of the City of London, and his attendance on the *R. Society*, he hath not yet been able quite to finish for the Press.

Now this being so, that several judicious Persons do employ themselves in the inquiry after the Observables in the greater Parts of the World, there is no question but many remarkable things will be detected therein; and, (to speak more generally on this occasion,) since 'tis apparent, that the Ingenious and Diligent almost every where are entering more and more into Philosophical Leagues,

To the Reader.

for the discovery of the Works of God and the Operations of Nature, we cannot but entertain pregnant hopes, that notwithstanding all the oppositions of Lazy and Envious Men, a good harvest of considerable and useful knowledge will be reaped in time, and thence good store of fruitful seed be ministered for large successive crops of the same kind, for the magnifying of our great Creator, and the enobling and benefiting of Man-kind.

THE



THE
HEADS
OF THIS
TREATISE.

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2. The Author's hopes of determining that great and much controverted Question about Marine Bodies, found at a great distance from the Sea. p. 8.
3. A General Problem asserted, whence depends the Explication of all the Difficulties about this Subject; which Problem the Author affirms to have so resolv'd, that no Sect of Philosophers shall find just cause to except against the Principles and Notions by him supposed for its Explication. p. 8.
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The Heads of this Treatise.

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 p. 30. l. 3. r. *glanduls.* p. 56. l. 2. r. *quadri-*
teral. p. 67. l. 3. r. *thought it a.*





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MOST SERENE
Great DVKE.



IT often befalls Travellers
in unknown Countries,
that hastening thorow a
Mountanous Tract unto
a Town standing on the
top of an Hill, they think
it hard by, as soon as they come in sight
of it; although the manifold windings
and turnings of the ways leading there-
to, retard their hopes even to a trouble.
For they have only a view of the neereſt

B

tops,

tops, but they cannot guess what is hidden by the interposition of these high places; whether they be lower Hills, or deep Vallies, or plain Fields, because with their flattering hopes they measure the distances of places by the eagerness of their desires. 'Tis no otherwise with those, that travel to the true knowledge of things by *Experiments*: For no sooner have they the least stricture of a truth unknown, but they imagine, the whole shall immediately open it self to them; nor can they make a true estimate of the time requisite to solve that continued *series* of difficulties, which by little and little, rising out of hidden depths, and stil casting new impediments in the way, slacken the pace of those that made so much haste to attain the end of their course. The *beginning* of an Inquiry and Labour shews only some common and vulgarly known difficulties; but the particulars wrapp'd up in them, the falsities to be removed, the truths to be establish't, the obscurities to be cleared, are seldom detected by any, until the thred of the Investigation have led him unto them. Nor was it amiss, that *Democritus*

made

made use of the similitude of a Pit, where a Man can hardly make a right estimate of the labour & time of drawing thence, but by having actually drawn up the things in it; for as much as the number and plenty of the latent Veins leave it very uncertain, what store there is of the subterraneous matter.

You will not wonder therefore, *Most Serene Prince*, if for above a whole Years time, I have almost every Day said, that that Disquisition, which was occasioned by the Considerations upon the *Teeth* of a *Canis Carcharius*, * was nearly finish'd. For having once or twice seen those Grounds, out of which are digg'd up *Shells*, and such like other things cast out by the Sea, and found, that those Earths were the Sediments of a turbid Sea, and that every where we might estimate the number of times, how often the Sea had been troubled here and there, I hastily not only imagined by my self,

* A *Shark fish*; concerning which this Author published a Discourse in his *Description of Muscles*; of which an Account was given No. 32. of the *Phil. Transact.* p. 627.

but confidently affirmed to others, that the whole business would be an Inquiry and Work but of a very small time. But when thereupon I am more attentively searching into particular Places and Bodies, there arise continually so many doubts close following one another, that I often finde my self brought back again as 'twere to the beginning of my Course, when I thought I was very neer the end thereof. I may resemble those doubts to the *Lernean Hydra's* Heads, because I had no sooner dispatched one, but innumerable others grew up in their place: At least I found my self wandering in a Labyrinth, where, the neerer you are to the out-let, the more windings you finde your self engaged in.

But I shall not stay to excuse this tardiness of mine, considering it is so well known to your *Highness*, how difficult experimental Disquisitions are. But that I, after I have overcome a great part of the newly intimated labour, when I should attempt some thing in *Anatomy*, do now desire leave to return into my Country, this indeed would need an Apology, if I did not know, that your
Highness

Highness will not be displeas'd at that Obedience in the Subjects to another Prince, which, on the like occasion, you would applaud in your own. Which hope conceiv'd by me of your Goodness, is rais'd higher by that singular favour, by which, when you vouchsafed to appoint me a liberal Pension for the advancement of my studies, you were pleas'd to leave me a liberty of returning into my Country, when occasion should require it. Since therefore I dare not make so long a stay, as is necessary to finish my Labors begun, I shall for the performing of my promise, do what is commonly practis'd by those that are in great debts; who, that they may not be bank-rupt, when they have not what is sufficient to pay all, do pay what they have: So I, since I am not able to dispatch all what was to be offer'd to *Your Highness*, think my self oblig'd, least I should appear to have amus'd you with meer words, to present you with the chief things of my performance in this Argument.

I would willingly have differ'd all till being returned home, I might have per-

fected every part of it, but that *I* must
 there expect the like fortune, which *I*
 have met with every vvhhere, vvhich is,
 that *new* Labors have alvways proved an
 impediment to the dispatch of *others*
 formerly begun. My Design of descri-
 bing all the *Glanduls* of the Body, was
 directed by my search into the wonderful
 Fabrick of the *Heart*. My endeavours
 concerning the *Heart* were interrupted by
 the Death of some of my nearest Rela-
 tions. When *I* was upon giving a par-
 ticular & minute account of the *Muscles*,
I was taken off by a *Dog* of a prodigious
 bigness, which your Seas presented us
 with; And whilst *I* am altogether ad-
 dicted to the present Experiments, *I* am
 called away by Him, whom the Lawv of
 Nature, and the great Favours conferr'd
 on me and mine, command and press me
 to obey. Why all these things do so
 happen, *I* will not anxiously enquire;
I should perhaps attribute to my self,
 what depends from a Superiour Cause.
 If to such discoveries, as are not mine, *I*
 should by long Meditations have added
 something as 'twere of mine, certainly
 if *I* had very long insisted in improving
 one

one Invention, I should have barred my self from finding out others. Not knowing therefore, what other Experiments and Studies may abide me else-where, I thought I might do well, here to deliver those things touching *Solids naturally included within Solids*, which might be a pledge of my grateful disposition for benefits and favours received, and which also might afford occasion to others, that enjoy leisure, to improve the Study of Natural Philosophy, and of Geography, with more advantage.

Concerning then the *Production of Solids naturally inclosed within Solids*; I shall *First*, shortly delineate the Method of my Dissertation; and *next* succinctly discourse of the more uncommon things, which occur upon that Subject.

The Dissertation it self I had divided into *Four Parts*; The first of which being a kind of *Introduction*, sheweth, that the *Question* about *Marine Bodies*, found at a great distance from the Sea, is ancient, delightful, and of use; but that the true Solution of it, which in former times was less doubtful, hath in the later times been made much more uncertain. And

having thereupon declared the Reasons, why later Authors have receded from the Opinion of the Antients, and why hitherto the Controversie hath not been fully decided, though many things be found very well written upon by divers, yet at length returning to You, *Most Serene Prince*, after many other things, partly found a new, partly freed from old doubts by your Patronage and encouragement, I show that we owe also to You the hope we have, that this matter also will shortly be brought to an issue.

In the *Second Part* is resolved the *General Probleme*, whence depends the Explication of every difficulty in this Point, which is, *A Body of a certain Figure, and naturally produced, being given, to finde in the Body it self Arguments, discovering the Place and Manner of its Production.* Here, before I proceed to make out this Probleme, I endeavour to explain all the words thereof in that sense, which no Sect of Philosophers shall find any thing in to except against it.

The *Third Part* I have designed for the Examination of the *particular Solids* included

cluded in a Solid, according to the Laws laid down in the Resolution of the *Probleme*.

The *Fourth* Part sheweth the several states of *Hetruria* or *Toscany*, untouched by Historians and Writers of Natural History; and proposeth a way of the *General Deluge*, not repugnant to the Laws of Natural Motions.

And these particulars I had begun to deliver in the *Italian* Language, both because I understood, it would be acceptable to Your *Highness*, and also that I might manifest to that *Illustrious Academy*, which hath received me into their Body, that I, who am very unworthy of that honour, do exceedingly covet to express my endeavour to attain some knowledge of the *Toscan* Language. Nor am I displeas'd, that a necessity is impos'd upon me to put off that writing; for, as the approaching *Voyage* promiseth me a fuller knowledge of those things, which may serve to clear up this Argument; so a greater space of time giveth me hopes, I may make a more happy progress in that Language.

As to the *Things* themselves, discours'd
of,

of, according to the lately mentioned Method, it would be tedious, to transcribe all the Observations together with the Conclusions thence deduced. Wherefore I shall here relate only, sometimes Conclusions, sometimes Observations, according as it shall seem most proper to indicate things with brevity and plainness.

Now therefore that in the Resolution of Questions about Natural things most Doubts remain not only undecided, but are for the greatest part of them, according to the number of Writers, increased, this seems to me chiefly to depend from *Two Causes*.

The *First* is, that few Men undertake to discuss *all* those difficulties, without the resolution of which the clearing of the Question remains imperfect. Of this the Argument now under consideration affords an eminent Example. The Ancients were exercised with one only difficulty, which was, How *Marine* Bodies came to be left in Places remote from the Sea; nor was it ever made a question amongst you, Whether such Bodies came from any Place else than the Sea.

But

But in latter Ages the difficulty, which was amongst the Ancients, hath been more sparingly urged, and instead thereof, they have almost all busied themselves about the Origin of the said Bodies. Those that adscribed them to the Sea, labour'd to shew, that such kind of Bodies could not be produced otherwise. The *others* that attributed them to the Earth, denyed, that the Sea could ever cover these *Lands*, where they were found; and they employed their wit in extolling the Powers of Nature, as able to produce any thing whatsoever. And though the *Third* Opinion, which will have some of the said Bodies to be due to the Earth, others to the Sea, want not Patrons and Abettors; yet there is almost every where a deep silence of the Doubt of the Ancients; only that some make mention of Inundations, and I know not what immemorial course of Ages; though they do that but overly, and as 'twere by the by. That therefore I might comply with the Laws of an *Analysis*, as far as I could, I have so often woven over and over the Webb of this Inquiry, and searched through every part thereof, till I found

no difficulty left in the reading of Authors, nor in the Objections of Friends, nor in the Inspection of Places, which either I have not resolved, or at least determin'd, as far as by the things, hitherto discover'd by me, could be resolved. The *First Question* was, Whether the *Glossopetra* of *Maltha* had formerly been the **Teeth** of Sea-Doggs: Which quickly appear'd to be the same Question with that *General* one, namely, Whether Bodies like to Marine Bodies, found at a great distance from the Sea, had been anciently produced in the Sea? But now, since there are found in the Earth other Bodies, that are like those, which grow in sweet Waters, in the Ayr, and other Fluids; if we give to the Earth a power to produce these Bodies, we cannot take from her the faculty of producing others: And therefore the Question was to be extended to all those Bodies, which being digged out of the Earth, are found *like* to those, which elsewhere we see grow in a Fluid. But we also finde in Stones, many other Bodies having certain Figures, which if one shall say they are there produced by the power of the place,

place, he will be necessitated to acknowledge all others to be produced by the same power. So that I have found the matter reduced to this, that we were to examine *Every Solid naturally included in a Solid, viz.* Whether it was produced in the same place where it is found, that is, we were to consider the nature *both* of the place where it is found, *and* of the place where it is produced. But no Man will easily determine the *Place* of Production, who knows not the *Manner* of the Production; and all discoursing of the manner of Production will be to no purpose, if a certain knowledge be not had of the *Nature* of Matter. Whence it appears, how many Questions are to be resolved only to satisfie one.

The *other* Cause, feeding doubts, seems to be this; That in the Examination of Natural things, those that cannot be certainly determin'd, are not distinguish'd from such, as may be so; Whence arise two principal sorts of Philosophers: *Some* are scrupulous to assent even to Demonstrations themselves, apprehending least in them also there should lurk the like error, as they have frequently discover'd

discover'd in other Assertions: *Others*, on the contrary, will by no means be confin'd to hold only those things for true, which no Man of sound reason and good sense will disbelieve, but they esteem all those things true, which to them appear to be pretty and ingenious. Yea, the Patrons of Experience themselves have seldom observed that moderation, but have either rejected even the most certain Principles of Nature, or have held the Principles invented by themselves for demonstrated. Therefore to avoid this Rock also, I have deem'd fit to urge that in *Physicks*, what *Seneca* hath often inculcated in *Morals*; where he affirms those Precepts of *Manners* to be the best, which are common to all, publick, and agreed unto by all of all the Families of Philosophers, *Peripateticks*, *Academicks*, *Stoicks*, *Cynicks*. And indeed, me thinks, that those Principles of Nature cannot but be best, which are common, and publick, and acknowledged by all Schooles, as well by those, that are Lovers of Novelty, as those that are addicted to Antiquity.

Wherefore I determine not, Whether the

the Particles of a Natural Body may, as to their Figure, be changed or not? Whether there are little Vacuities or no? whether there be in those Particles, besides *Extension*, and *Hardness*, some others unknown to us? For these are not *Publick Voyces*; and 'tis a weak Argument, to deny that there is something else in a thing, because I do not observe it there.

But I do without hesitation deliver;
 1. That a Body Natural is an Aggregate of insensible Particles, pervious to Operations flowing from the Magnet, the Fire, and sometimes also from Light; in what manner soever the open passages be found either *between* the Particles, or *in* the Particles themselves.

2. That a *Solid* herein differs from a *Fluid*, that in a *Fluid* the insensible Particles are in perpetual motion, and part from one another; but in a *Solid*, although the insensible Particles be moved sometimes, yet they scarce ever part from one another, as long as that *Solid* remains a *Solid* and entire.

3. That, whil'st a *Solid* Body is produced, the Particles thereof are mov'd from one place to another.

4. That

4. That hitherto in the nature of Matter there is nothing known to us, whereby the Principle of the Motion, and the Perception of Motion may be explicated; but that the determination of Natural Motions may be changed from *three Causes*.

First, From the Motion of the Fluid permeating all Bodies; and what things are this way produced, are said by Us to be produced *Naturally*.

Secondly, From the Motion of Animals; and the things that are done this way are many of them called *Artificial*.

Thirdly, From the first and unknown Cause of Motion; and in those that are done this way, the *Pagans* themselves believed there was something of Divine. Certainly to deny to this Cause a power of producing effects contrary to the usual course of Nature, is the same, as if we should deny to Man the power of altering the Course of Rivers; the power of kindling Fire in places, where without it it would never be kindled; of extinguishing Light, which else would not vanish but by the ceasing of matter; of inoculating a twig of one Plant into the branch
of

of another Plant; of bringing upon a Table the Fruits of Summer in the midst of Winter; of producing Lee in the heats of Summer, and a thousand such other things, repugnant to the ordinary Laws of Nature. For, if we our selves, who do ignore both our own Fabrick, and that of other Bodies, do daily change the Determination of Natural Motions; why should not He be able to change the determination of the same, who doth not only know, but hath produced *our* frame, and *that* of all other things? Now to be ready to admire in Artificial things the Wit of Man acting freely, and yet to deny to things produced by Nature a Free Mover, *that* indeed would seem to me a great simplicity in a pretended subtilty, whereas Man, when he hath made the most Artificial things, does not see but very darkly what he hath done, nor what Instruments he hath used, nor what is that cause that moveth the Instruments.

All these particulars I do at large discourse of, as demonstrated both by Experiments and Reason; to shew, that there is none of the Philosophers, but he either saith the same, though he do not always

use the same words, or, if he speak differently, yet admits the same, whence these things necessarily follow. For, what I have affirm'd of *Matter*, hath place every where, whether you take Atoms for your Matter, or Particles a thousand ways variable, or the Four Elements, or the Chymical Principles, never so much varied according to the variety of Chymists. So also what I have propos'd of the *Determination* of Motion, agreeth with every Mover, whether you make it to be the Form, or the Qualities flowing from the Form, or the Idea, or the common Subtile matter, or the proper Subtile matter, or the particular Soul, or the Soul of the World, or the Immediate concurrence of God.

Conformably to the same, I give an account of the various ways of speaking, commonly received, whereby we diversly explain the different production of different, and sometimes of the same Bodies. For, whatever contributeth any thing to the production of a Body, *that* acts either as a *Place*, or as *Matter*, or as a *Mover*; hence when like produceth like, it giveth it both *Place* and *Matter*, and the *Motion*

Motion of production; as a Plant, included in the seed of a Plant, had from another Plant *both* the Matter *wherein* 'tis produced, *and* the Matter *out of which* 'tis produced, *and* the Motion of the Particles by which 'tis formed: which same thing is certain of Animals included in the Egg of the like Animals.

Whilst the *particular Forme*, or the *Soul*, produceth a thing, the motion of the Particles in the production of that Body is determined by some particular Mover, whether it be the Mover of another like Body, or some other thing like to this Mover.

The things said to be produced by the *Sun*, have the Motion of their Particles from the Sun-beams, as those, that are adscribed to the Influences of the Stars, may have from the Stars the motion of their Particles. For it being certain, that our Eyes are moved by the light of the Stars, it will also be beyond all controverſie, that the reſt of matter is likewise capable to be moved by the ſame.

What the *Earth* produceth, hath nothing else from the Earth, than the Place in which it is produced, and the matter

ministred to it through the Pores of the Place.

Things produced by Nature have the motion of their Particles from the motion of some penetrating Fluid, whether that Fluid come from the Sun, or from Fire contained in some terrestrial matter, or from any other cause unknown to Us, as an Instrument to the Soul, &c.

He therefore that ascribeth the production of a thing to *Nature*, intimateth and nameth the *Mover General* in the production of all things. He that taketh in the *Sun*, doth somewhat more define the same Mover. He that nameth the *Soul*, or a *Particular Forme*, alledgeth yet a more determinate cause than the other. Mean time, who ever shall duly weigh the Answers of all these, will find nothing in them but what's occult, for as much as *Nature*, the *Sun-beams*, the *Soul*, and a *Particular Form*, are nothing else but *Names*. But since that in the production of Bodies, there are, besides the *Mover*, to be also consider'd the *Matter* and *Place*, it hence appears, that not only the Answer is more unknown than the thing sought, but also very imperfect, when

when 'tis said, that *Cockle-shells* found in the Earth are produced by *Nature*, because those likewise that grow in the Sea, are the workmanship of *Nature* also. 'Tis true that *Nature* produceth *all*, seeing that in the production of all things, penetrating Fluids have their place: But then it may also be justly said, that *Nature* produceth *nothing* by her self, because she expects determination from the Matter that is to be moved, and from the Place. As for Example, *Man*, who may do any thing, if all necessaries be at hand, but they being wanting, he shall do nothing.

He that shall adscribe the production of a thing to the *Earth*, nameth, 'tis true, a *Place*; but since to all terrestrial things the *Earth* affords *place* (at least in part) and yet the place alone is not sufficient to produce a *Body*, it may be said of the *Earth*, what was lately said of *Nature*, *viz.* That all the things that are produced *in* the *Earth* are produced *by* the *Earth*; and again, that of all the things that are produced *in* the *Earth*, none is produced *by* it.

These very things, which are but few,

thus declared, are sufficient to resolve all the doubts of the *Question proposed*, which I shall here comprehend in the three Propositions following.

I.

If a Solid Body be every where encompass'd by another Solid Body, that of the two was first hardned, which in the mutual contact doth express on its superficies the proprieties of the superficies of the other.

Hence observe,

1. That in those Solids, whether Earths, or Stones, which do round about environ and contain Chrystals, Selenites's, Marcasits, Plants, and their parts, Bones and Shells of Animals, and such other Bodies having a smooth surface, those very Bodies were then already hardned, when the Matter of the Earths and Stones containing them was yet fluid; and consequently that those Earths or Stones are so far from having produced the Bodies contain'd in them, that they were not there existent, when those Bodies were there produced.

2. If there be in part included a Chrystal in a Chrystal, a Selenites in a Selenites, a Marcasite in a Marcasite, that these
Bodies

Bodies contain'd were then already hard, when a part of the Bodies containing was yet fluid.

3. In those Earths and Stones, wherein are contained Chryftallin and Lapidaceous shells, Veins of Marble, of Lapis Lazulus, of Silver, Quicksilver, Antimony, Cinnaber, Copper, and other such Minerals, the Bodies containing were then already hard, when the matter of the Bodies contain'd was yet fluid; and consequently Marcasites were produced first; then the Stones wherein they are included; then the Veins of Minerals, which fill up the fissures of the Stones.

II.

If a Solid Body be every where like another Solid, not only as to surface, but also in the inner constitution and frame of its parts and particles, then it will also be like it as to the Manner and Place of its production, excepting those conditions of place, which are often found in a place and are no advantage or disadvantage to the production of a Body.

Whence it follows,

1. That the *Beds* of the Earth, for the place and manner of their production,

agree with those Beds, which turbid Waters let fall.

2. That Rock or Mountain-Chryftals, for the manner and place of production, agree with Chryftals of Niter; though it be not therefore necessary, that that Fluid be *aqueous*, in which they are produced.

3. That those Bodies, which being digg'd out of the Earth, are altogether like the parts of Plants and Animals, were produced in the same manner and place, in which the very parts of Plants and Animals are produced. But to the end that the ambiguous sence of the word *Place* may not beget new doubts, I shall obviate that difficulty.

I understand therefore by the word *Place*, that Matter, which by its superfice immediately toucheth the superfice of that Body, which is said to be in that *Place*: which Matter admits of various differences; for,

First, 'Tis either all solid, or all fluid, or partly the one and partly the other.

Secondly, 'Tis either all sensible by it self, or in part so, and in part by its operations.

Thirdly,

Thirdly, 'Tis either altogether contiguous to the Body contain'd, or in part continuous to the same.

Fourthly, 'Tis either always the same, or by little and little changed. Thus a place wherein a Plant is produc'd, is that matter of the like Plant, within which the little Plant is form'd. So the Place, wherein a Plant grows, is all that matter, which by its superficie immediately toucheth the whole superficie of the Plant, sometimes made up of Earth and Air, sometimes of Earth and Water, sometimes of Earth, Water and Air, sometimes of a Stone alone and of Air, as in sub-terraneous places there are often seen Roots of small Plants wholly sticking to the surface of a Toph-stone, not cover'd at all by any Earth or Dust. So the place, where from a fallen blossom grows an Orange, is partly the little *pedunculus* or stalk continuous to it, partly the contiguous Air. Likewise the Place, where an Animal first begins to grow, is partly the liquor of the *Amnion* contiguous to it, partly the continuous Umbilical Vessels diffus'd through the *Chorion*.

III.

If a Body be produced according to the Laws of Nature, it is produced out of a Fluid.

In the production of a Solid Body there should be consider'd the first Lineaments as well as the increase of it. But, as I candidly acknowledge that the *first Delineation* of them is not only doubtful but quite unknown to me, so I esteem without almost any scruple, that the following particulars are true concerning their *Increase*.

A Body increaseth by an Apposition of new Particles severed from an *External* Fluid: But this Apposition is made either by an external Fluid *immediately*, or *mediately* by an internal Fluid, one or more.

Such parts as are from an External Fluid *immediately* joyned to a Solid, do in some, fall down to the bottom by their own weight; in others, being by the penetrating Fluid of a Solid determin'd towards a Solid, are either joyned round about to the Solid, as in *Incrustations*, or only to certain places of the solid surface, as in those Bodies, which represent
Threads,

Threds, Branches, and Angular Bodies. Where (by the by) it may be noted, that the said ways are sometimes continued, until some space be wholly filled up by them; whence come *Repletions*, which sometimes are simple and plain, sometimes composed of *Crusts*, or of *Sediments*, or of *Angular Bodies*, or of divers, variously mixt among themselves.

Those Particles, which by an *intermediate* internal Fluid are joyned to a Solid, either assume the Figure of Fibres (in as much as *partly* they are conjoined according to the length of the extended small fibre, the pores being open'd, *partly* as they are, in the interstices of the small fibres, by the permeating Fluid disposed for the figure of a new small fibre,) or make simple repletions: by which two kinds of parts, Plants and Animals are composed. Being less versed in the *Anatomies* of *Plants*, I determine not, whether there be in them several inward Fluids; in *Animals* 'tis certain that there are, which I shall endeavour to reduce into order.

Besides a Subtil fluid pervading all, we observe at least *three* sorts of Fluids
in

in Animals, of which the first is *External*; the second, *Internal* and *Common*; the third, *Internal*, and *Appropriate* to each part.

By the word of *External* Fluid in Animals I understand not only that, which encompasseth the visible surface like an Atmosphere, but that also, which toucheth all the other surfaces of the Body that by the greater holes are continued to the said surface; such as are, the surface of the *Aspera arteria* or Wind-pipe, which the Air inspired toucheth; the whole surface of the way of the Aliment, by which I mean the Mouth, the Wealand, the Stomach, and the Entrals; the whole surface of the Bladder and the *Urethra*; the whole surface which hath communication with the Womb, at least in the years of ripe age; the whole surface of all the excretory Vessels, continued from the capillaries unto the orifices, which discharge their contents into the Ears, Eyelids, Nostrils, Eyes, the way of Aliments, the Bladder, the *Urethra*; the Womb, and the Skin; the particular enumeration and description of which would show, that many are indeed extrinsick, which are esteem'd

steem'd intrinsic, and even inmost, by the Vulgar; and consequently,

1. That the Worms and Stones generated *within* our Body, are most of them produced in the *external* fluid.

2. That divers parts are necessary to Animals, because they are there, not that the Animal could not *be* without them.

I call the Fluid, which toucheth these surfaces, *External*, because it communiceth with the ambient fluid by channels without any intermediate capillary Vessels, that is, without percolation or straining: whereby it comes to pass, that though the cavities, containing the said fluids, be sometimes shut, yet as often as they are open'd, they discharge all the parts of the retain'd Fluid without discrimination.

I call that Fluid *Internal*, which hath no communication with the *External* fluid, but by the intermediate strainers of the Capillary Vessels, and therefore naturally never transfuseth all its parts into the outward Fluid without some difference.

The *Common* internal Fluid is that,
which

which is contained in Veins, Arteries, and Lymphatick Vessels, at least those, which are betwixt the conglobate glanduls and the Veins intercepted. I call this fluid *Common*, because it is distributed towards all the parts of the Body. Of that other Common Fluid, which is contain'd in the Nervous substance, since 'tis less known, I determine nothing.

An *Appropriate* internal Fluid is that, which is circumfused about the capillary Vessels of the *common* Fluid, and is different according to the diversity of places: for there is another in the sanguineous *parenchyma's*, another in the exanguious ones; another, about the moving fibres; another, in the Egg-shell; another, in the substance of the Womb; another in other places. Nor is that Opinion agreeable to Reason or Experience, which holds, that the extremities of the Veins and Arteries terminate in every the smallest particle of the Body, for the distribution of warmth and food to them all; but there are every where cavities, into which the parts sever'd from the blood are mixed with the Fluid of that place, and thence to be added to the solid parts; as again
the

the Particles worn off from the solid parts fall back again into those hollow-nesses, to be again restored to the blood, and thereby to be conveyed away to the external Fluid. The Fluid of these cavities is in divers things consonant to the Doctrin of the great *Hippocrates* concerning *Flatu's*: Although I am not able to determine, why in divers places from the same blood are discharged different Fluids; yet I hope that there wants but little for the determination of it, in regard 'tis certain, that that depends not from the Blood, but from the Places themselves; the consideration of which may be included in these three particulars.

First, By considering the Capillary vessels of the *common* internal Fluid; which is alone heeded by those, who ascribe all to the percolation through divers Pores; of which number I once was my self.

Secondly, By considering the *Appropriate* internal Fluid; about which alone those are conversant, who attribute to every part a peculiar Ferment; whose Opinion may be true in part, though the word *Ferment* depend on a comparison taken from so peculiar a thing.

Thir dly,

Thirdly, By considering the Solid of every part; to which those adhere chiefly, who by attributing to each part its forme, do intimate that they acknowledg there to be something proper, which yet is unknown to us; and which according to that knowledge of matter, that we have hitherto obtained, can be nothing else but a Porous surface of that Solid, and a subtile Fluid permeating those pores.

I should too much wander from my subject, if I should apply the things, I have discours'd of, to what daily happens in our Body, and cannot be rationally explicated otherwise. It may be sufficient to have hinted here, that the Particles, which do many ways part from the external Fluid, are carried into the internal Fluid, by the means of Percolation; whence being likewise variously sever'd, and by a new cribration transmitted into the Appropriate internal Fluid, they are added to the solid parts, either by way of Fibres, or Parenchyma's, according as they shall have been determin'd by the to us yet unknown propriety of every part, included in the consideration of the
three

three lately mention'd particulars.

If therefore you have a mind to reduce, by the related Method, the Solids naturally included in Solids, to certain Heads, you will finde, that,

I. *Some* of them are produced by Apposition from an External Fluid, which may be referr'd either to *Sediments*, as the Beds of the Earth; or to *Incrustations*, as the Agat, Onyx, Chalcedony, Eagle-stone, Bezoar, &c. or to *Threds*, as Amianthus, Alumen plumosum, and various kinds of Threds, found by me in the fissures of Stones; or to *Ramifications*, as those figures of Plants, which are seen in the crevices of stones, and are but superficial; and certain branchings in an Agat seen by me, whose trunks insisted on the superfice of the outer plate, but the branches spred themselves through the substance of the inner plate; or to *Angular Bodies*, as Rock-Chrystal, Angular Bodies of Iron and Copper, Cubes of Marcasites, Diamonds, Amethysts, &c. or to *Repletions*, as all sorts of party-colour'd Marbles, Granats, Dendroidids, Stony and Chrystallin Shells, Metallick Plants, and many such like Bodies, filling

up the places of Bodies consumed.

2. *Others* are produced by Apposition from an *Internal* Fluid; which are referable either to *Simple Repletions*, as Fat, Brawniness uniting broken Bones; a Gristly substance connecting cut Sinews; Affusions chiefly constituting the substance of the Guts, Marrow both in Plants and Animals: or to *Fibrous parts*, as are the fibrous parts of Plants; and in Animals the nervous fibres, and the moving fibres; all which are solid Bodies, and for the most part naturally included in Solids.

If therefore every Solid hath had its increase (at least,) from a Fluid; if Bodies, that are altogether like one another, have been produced after a like manner, and if of two Solids, contiguous to one another, *that* was hardned first, which exhibits on its surface the proprieties of the other's surface; it will be easy, when a Solid is given, and the Place where 'tis, to pronounce something certain of the manner and place of its production.

And thus much for a *General* Consideration of a *Solid contain'd within a Solid.*

I proceed therefore to examine more particularly those Solids digg'd out of the Earth, which have occasioned many controversies, especially *Incrustations*, *Sediments*, *Angular Bodies*, *Shells* of dead Sea-Animals, and the *Figures* of *Cockles* and *Plants*.

To *Incrustations* do belong all sorts of Stones made up of *Lamella* or *Plates*, the two surfaces of which are indeed parallel, but lye not in the same plain. The Place where *Incrustations* are made, is the whole confine of the Fluid and Solid; whereby it comes to pass, that the Figure of the *Plates* or *Crusts* answers to the figure of the *place*, and that 'tis easily determinable, which of them was concreted first, which last: For, if the Place be *Concave*, then the outer crusts were formed first; if *Convexe*, the inner: If the Place be *Un-even* by various great protuberancies, there, when the narrower spaces were fill'd up by *Plates* first made, new *Plates* were produced in the larger spaces. Whence 'tis easy to render an account of all the varieties of *Figures*, which are seen in the *Cuts* of such Stones, whether they represent the round *Veins*

of a transversly dissected Tree, or imitate the winding flexures of Serpents, or run otherwise, inflected at randome. Nor is it to be wondred, that *Agats*, and other kinds of Incrustations appear, on the outer surface, rough like common stones, considering that the exterior surface of the outer Plate expresseth the roughness of the Place. But in Torrents such kinds of Incrustations are often found out of the place of their production, because by the rupture of the Beds the matter of the place hath been thrown here and there.

Touching the *Manner*, how from a Fluid the particles of the Crusts, that are to be conjoynd to the Solid, are sever'd, these particulars, at least, are certain.

1. That Levity or Gravity hath no place there.

2. That the said particles are joynd to all sorts of superficies, because that smooth, rough, even and crooked superficies, and such as are made up out of divers plains variously inclined, are found covered with crusts.

3. That the Motion of the Fluid is no impediment to them.

Mean

Mean while, whether the substance which floweth from the Solid, be different from that which agitateth the particles of the Fluid; or whether we are to search for something else, I shall not determine.

The *Varieties* of Plates in the same Place may be deduced *either* from the diversity of the particles that come away from the Fluid, according as one and the same fluid is by degrees more and more resolved; *or* from divers Fluids conveyed thither at divers times; whereby it comes to pass, that there is sometimes reiterated the same rank of *Lamelle* in the same place, and that there appear often manifest marks testifying an ingress of new matter.

But all the *Matter* of Plates seems to be the finer substance exhaling out of Stones; as may be made out by what is to follow hereafter.

To the Sediments of Fluids do belong the *Strata* or *Beds* of the *Earth*.

*The Strata or
Beds of the
Earth.*

I. Because it appears not, that the Dusty matter of the Beds can have been otherwise reduced into that Figure, if it

had not, by being commix't with some Fluid, & falling thence by its own weight, been made plain by the motion of the same incumbent fluid.

2. Because the greater Bodies contain'd in the same Beds do for the most part observe the Laws of Gravity, *both* as to the scite of each Body by it self, *and* as to the scite of various Bodies amongst themselves.

3. Because the Dusty matter of the Beds hath so accommodated it self to the Bodies contain'd, that it hath *both* filled up every small cavity of the contain'd Body, *and* expressed the smoothness and brightness of the same Body in that part of its surface where it toucheth it, though the roughness of the Dust answers not at all to such a smoothness and gloss.

But the *Sediments* are made thus, *viz.* that the Matter contain'd in a Fluid falls by its own weight down to the bottom, *whether* those things contain'd be convey'd thither from elsewhere, *or* be by little and little secreted from the very particles of the Fluid, and that *either* in the upper surface, *or* equally from all the particles of the Fluid.

Although

Although there be a great affinity between *Crusts* and *Sediments*, yet they are easily discerned by this, that the upper surface of *Crusts* is parallel to the lower surface, though very rough; but the upper surface of *Sediments* is parallel to the Horizon, or else very little declining from it. Thus in Rivers the Mineral *Crusts*, which sometimes are green, sometimes yellow, sometimes reddish, take not away the Unevenness of the stony bottom; but the Sediment of Gravel or Clay maketh all plain: whence I have been able very easily in divers compounded Beds of the Earth to distinguish *Crusts* from *Sediments*.

About the Matter of *Beds* the particulars following may be determined.

1. If in a Stony Bed all the Particles be of the same nature, and withall fine, it cannot rationally be denied, that that Bed was produced at the time of the Creation out of that Fluid which then overwhelmed all: After which manner Monsieur *Des-Cartes* also explains the production of the *Beds* of the Earth.

2. If in any Bed there be found the fragments of another Bed, or the parts

of Animals or Plants, 'tis certain, that such Beds are not to be reckoned among those, which in the Creation did subside from the first Fluid.

3. If any Bed do give us notice of any Sea-salt, of spoiles of Sea-animals, of Ship boards, and we shall finde the like substances at the bottom of the Sea; 'tis certain, that one time or other the Sea hath been there, in what manner soever, whether by its own overflowing, or by eruptions of Mountains, it got thither.

4. If in some Bed or other we find a plenty of Reed, Grass, Pine--Apples, Branches or Bodies of Trees, or the like, we may suspect, that that matter was carried thither by the overflowing of a River, or the fall of a torrent.

5. If in a Bed there be Coals, Ashes, Pumice-stones, *Bitumen*, and calcined Bodies, 'tis certain, that neer that Fluid there hath been an Eruption of Fire, and that the rather, if the whole Bed be made up of meer Ashes and Coals: Of which kind I have seen one without the City of *Rome*, where they digg out matter for Bricks.

6. If in the same place the Matter of

all

all

all the Beds be the same, 'tis certain, that that Fluid hath not received fluids of a different nature, from divers places at several times flowing thither.

7. If in the same place there be different matter of Beds, then *either* at several times from divers places there hath been a conflux of different sorts of Fluids (whether caused by various winds, or impetuous falls of rain in certain places,) *or* there hath been in the same sediment, matter of different gravity, whereby the heavier bodies have fallen to the ground first, the lighter afterwards: Which variety a vicissitude of tempests may have occasioned, especially in places where an equal inequality of grounds is seen.

8. If amongst the Beds of the Earth there be found some Stony Beds, 'tis certain, *either* that near that place there hath been a spring of petrifying Water, *or* that sometimes there have happen'd Eruptions of subterraneous steams, *or* that the Fluid, parting from the depos'd sediment where the upper crust was harden'd by the heat of the Sun, hath return'd again.

Concern-

Concerning the *Place* of Beds, the following particulars may be reckon'd among Certainties.

1. At the time that any Bed was formed, there was another Body under the same Bed, which did hinder the farther descent of that dusty matter; and consequently at the time that the lowest Bed was formed, there was under it *either* another solid Body, *or*, if some Fluid was there, *that was both* of a different nature from the upper fluid, *and* heavier than the solid sediment of the superiour fluid.

2. At what time there was form'd one of the upper Beds, the lower Bed had then already obtained a Solid consistency.

3. At the time that any Bed was formed, it was *either* at the sides environ'd by another solid Body, *or* it did cover the whole Globe of the Earth. Hence it follows, that, where-ever there are seen any naked sides of Beds, there is *either* to be sought for a continuation of the same Beds, *or* there must be found out another solid

solid Body, which kept the matter of the Beds from falling asunder.

4. At what time there was formed any Bed, the matter incumbent on it was all fluid, and by consequence, when the lowest Bed was laid, none of the upper Beds was extant.

Touching the *Figure*,

'Tis certain, that, when any Bed was formed, its inferior surface, and that of its sides, did answer to the surfaces of the inferior Body and of the Bodies lateral; but the superior surface was, as far as was possible, parallel to the Horizon: So that all Beds, except the lowest, were contained in two plains parallel to the Horizon. Hence it follows, that Beds, either *perpendicular* to the Horizon, or inclined to it, have been at another time *parallel* to the same.

Nor is it repugnant to what we have said, that the Scituation of the Beds is changed, and that their sides are bare, as in many places they may now be seen; because near those places there are manifest tokens of Fires and Waters. For,

as Water dissolving Earthy matter carrieth the same down to inclining places, both on the surface, and in the Cavities of the Earth; so Fire dissipating all solid Bodies in its way, doth not only expel their lighter particles; but sometimes also casts out their heaviest weights; whereby it comes to pass, that on the Surface of the Earth there are formed Precipices, and Channels; but in the Bowels thereof, subterraneous passages and Caverns; by the occasion of which, the Beds of the Earth may change their scite two ways;

The *First* is, a violent excussion of the Beds upwards, whether that be caused by a sudden accension of under-ground Exhalations, or by a forcible elision of Air occasioned by other huge neighbouring ruines. This excussion of Beds is follow'd by a dispersion of the Earthy matter, and by a breaking asunder the Stony matter into little stones and rubbish.

The *other* is, a spontaneous falling down of the upper Beds, when, the lower matter or foundation being with-drawn, the upper bodies have begun to crack; whence, according to the variety of cavities

vities and crevices there follows a various scituation of the broken Beds; for as much as some remain parallel to the *Horizon*; others become perpendicular to it; most make oblique Angles with it; some are bow'd into Arches, being made up of a tough matter: And this Change may happen *either* in all Beds imminent to cavities, *or* in some lower ones, the upper Beds being left entire.

This Changed scituation of Beds affords an easy explication of many things, else difficult enough to give an account of.

Hence a cause may be given of that Inequality, which on the Surface of the Earth occasions many controversies, as *Mountains* and *Valleys*, Receptacles of superiour Waters, Plainesses both in high and low places. But, to pass by the rest, I shall run over a few things concerning *Mountains*.

That the changed scituation of Beds is the chief *Origin* of *Mountains*, is thence apparent, that in the Heaps of Hills there are seen,

The Origin of Mountains.

1. Vast Plains on the tops of some.

2. Many

2. Many Beds parallel to the Horizon.

3. On their sides various Beds variously inclined to the *Horizon*.

4. In the opposite sides of Hillocks the faces of broken Beds, shewing a perfect resemblance of matter and shape.

5. Bare Rims of Beds.

6. At the foot of the same Heap, fragments of broken Beds, partly carried together into hillocks, partly dispersed over the neighbouring fields.

7. Most evident signs of subterraneous Fire *either* in the stony Mountains themselves, or in their neighbourhood; even as about the hillocks made up of Earthy Beds are found frequent Waters. And here it is to be noted by the by, that the little Hills, composed of Earthy beds, have commonly for their foundation some bigger fragments of Stony beds, which in many places keep the incumbent Earthy beds from being dissolved by the flood of high Rivers, and torrents; yea, they often defend whole regions against the violence of the Ocean; which the Row or border of Rocks, obtended to *Brazil*, and th^e every where obvious Rocky shores declare. But

But Mountains may also be produced otherwise, as by Eruption of Fires casting out Ashes and Stones together with brimstone and bituminous substances; as also by the impetuoufness of Rains and Torrents, whereby the *Stony* beds, being cracked before by the viciffitudes of heat and cold, are precipitated; but *Earthy* ones, that had been split by excessive heats, are dissolved into many pieces.

Hence it appears, that there are two main kinds of Hills and Hillocks: *one*, of those which are made up of Beds; of which there are again two sorts, some having abundance of *Stony*, others of *Earthy* beds; the *other* is of such, which rise up without any orders out of Fragments of beds and parts broken off. Whence it may easily be made out,

1. That all Mountains at this day have not existed from the beginning of things.

2. That Vegetation hath no place in Mountains.

3. That the Stones of Mountains have nothing common (besides some similitude of hardness) with the bones of Animals;

nimals; since they agree amongst themselves neither in matter, nor in the manner of production, nor texture, nor use, if so be, we may pronounce ought of a thing so little known as are the *Uses* of things.

4. That the Ridges or Chains of Mountains said to lye according to certain quarters of the Earth, answer neither to Reason, nor Experience.

5. That Mountains may be overturn'd and whole Fields transferred; the tops of Hills be raised and depressed; grounds opened, and closed again; and the like things happen, which in the reading of Histories are counted fabulous by those, that will not be taken for credulous.

The passages of things flowing out of the earth. The same Change of the situation of Beds affords an out-let to things flowing out of the Earth; such as are,

I. *Waters* springing out of Hills; and in the caverns of Mountains sever'd from the Air; *whether* they proceed from subterraneous Waters, *or*, being by the upper Air condensed within into one place, are thrust forth; which latter I believe to be very frequent, in regard that in
most

most caves, distilling copious Waters, I have seen all, above and below, solid.

2. *Winds* breaking out of Hills, *whether* they be Air dilated by heat, or that divers several Fluids, heated by their mutual concourse, do generate them.

3. Fetid *Exhalations*, and hot or cold *Ebullitions*, &c. Not is there any doubt left, *that* Cold and Dry places, as often as Water is poured on them, do bubble up without any sign of Heat; *that* at the sides of a very Cold Fountain there breaks out an Hot Spring; *that* by an Earth-quake an hot Spring may be changed into a cold one, and Rivers alter their course; *that* Valleys closed round about may cast the Rain-Waters into lower places; *that* Rivers fallen under ground may elsewhere come forth again; *that* in laying foundations Builders do often labour altogether in vain, meeting with Quick-sands, as they call them; *that* in some places, where Pits are digg'd, are first found Waters near the surface of the Earth, then, after the Earth hath been digged up to the depth of many feet, new Waters are met with, springing upwards, upon vent given, beyond

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the height of the first waters; *that* whole Fields with their Trees and Houses do by degrees subside, or are swallow'd un-awares, so that there come to be vast Lakes, where formerly stood Towns; *that* those who live on Plains are in *dan-ger* of such ruines, if they be not sure of a stony foundation under them; *that* at times there are open'd Gulfs exhaling a pestiferous Air, which by store of Bo-dies thrown in are again stopp'd up.

*The Origin of
variegated Stones,
& the Receptacles
of Minerals.*

The same changed Scite of Beds hath occasioned all sorts of *Variiegated Stones*, and prepared a *Receptacle* for most *Minerals*; whether *that* have happen'd in the Fissures of Beds, or in those Crevices, which were found in the Matter of them not yet hard, though dry, or between Plates, or in Scissures: Or whether in the Interstices between the upper and lower Beds, after the downfall of the inferiour Beds; or last-ly, whether in Void places left by the resolution of Bodies there contained. Whence,

I. It may be demonstrated, that 'tis a very slight, and indeed no foundation at all,

all, on which are built those minute and almost superstitious Divisions of Veins, used by Mine-men; and consequently that the Divination for store of Metals to be found, taken from the Roots and Branches of Minerals, is as dubious, as is ridiculous the opinion of some of *China* touching the *Head* and *Tail* of the *Dragon*, which they make use of for the finding out in Hills an auspicious and lucky scituation of sepulchers.

2. That most Mines, which Men labour after, have not been extant from the beginning.

3. That in the examination of Stones many things may be discover'd, which are in vain attempted in the examination of Minerals; since it is more than probable, that all those Minerals, which fill up the cracked or wider spaces of Stones, had, for their matter, Vapors driven out of the Stones themselves, *whether* that have been done before the *Beds* changed their scituation (which happen'd, I believe, in the Mountains of *Peru*;) or after they had done so: And consequently that in the place of the exhausted Metal there may grow a new one; which is rather

believed of the Iron-mine in *Elva*, that *known*, because that the Tools of Diggers, and the Idols found there, were surrounded not with Iron but Earth.

And these particulars I thought not amiss to examine somewhat diligently touching the *Beds* of the Earth, *both* because those *Beds* are Solids naturally inclosed in Solids, *and* that in them are contained almost all those *Bodies*, which gave occasion to the Question in hand.

What concerns the Production of *Chrystal*, I shall not venture to determine the *Manner* of its first delineation; but this at least is without controversy, that what I have met with concerning it in other Writers, is insignificant: For neither Irradiations (as some call it) nor the Figure of the Particles like to the Figure of the whole, nor the perfection of the *Hexagonal* figure, and the tendency of the parts to one and the same Center, nor such like other things do answer experience; as will appear from several Propositions, which I shall lay down, confirmed elsewhere by most evident Experiments. But to avoid confusion, it will be of use, first to explain

plain some Terms, which in nominating the parts of Chrystal I do employ.

Chrystal is composed of two Hexagonal *Pyramids*, and an intermediate *Column* likewise hexagonal: Where I call those the *Extreme Solid Angles*, that make up the Tops of the *Pyramids*; but those the *Intermediate Solid Angles*, which are made in uniting the *Pyramids* with the *Column*. After the like manner I call the *Planes* of *Pyramids*, *Extreme* planes, and the *Planes* of the *Column*, *Intermediate* planes. The *Plane* of the *Basis* is a Section perpendicular to all the *Intermediate* planes. The *Plane* of the *Axis* is a Section, wherein is the *Axe* of the *Chrystal*, which is composed of the *Axes* of the *Pyramids*, and the *Axe* of the *Column*.

The *Place*, where the first concretion of a *Chrystal* begins, is doubtful whether it be *between* two *Fluids*, or between a *Fluid* and a *Solid*, or *in* a *Fluid* it self. But the place, whence a *Chrystal* already formed increaseth, is solid on that part where the *Chrystal* leans on it, whether it be a *Stone*, or some other *Chrystal* before formed; and on the o-

ther part 'tis Fluid, if the impediments be remov'd, which may be found from the Unevenness of the Stone, or from other afore-produced Chrystals. Whether the ambient fluid be *Aqueous*, I dare not determine; and it is not cogent, what is alledged of *Water* inclosed in Chrystals, since 'tis certain, that there is Air included as well as Water, and that there are many Chrystals including Air alone; But then, if Chrystal were concreted in an *Aqueous* fluid, all spaces, every where clos'd up, would be full of Water, seeing it hath been constantly observed, that Water thus shut up did never vanish.

This *Place* is afforded to Chrystal by the Hollowneses of Stones, variously produced. Nor doth it hinder, that whole Hillocks are made up of Earthy matter very full of Chrystal, because that near the same Hillocks are found stony Mountains, apt to produce Chrystals; and even in those very hillocks of Earthy matter there are digged out very big Stones, broken off from the neighbouring Mountains; some of which have fissures filled up with Marble-matter, just

as in the stony Mountains themselves the Crevices of Beds are filled up. Now the same cause, which roleth the fragments of Beds, broken off from the neighbouring Mountains, upon Hillocks, may also have dispersed through the same hillocks such Chrystals as were beaten out of the cavities of the same Beds.

As to the Place of Chrystal, to which is joyned new Chrystallin matter, the following Propositions may shew, what is to be said thereof.

I. Chrystal increaseth by new Chrystallin matter being put to the external planes of already delineated Chrystal: so that their opinion can have no place at all, who esteem, that Chrystals have a Vegetative growth, and draw nourishment on that side where they stick to their *Matrix*, and that so the Particles received by the fluid of the stone, and transmitted into the fluid of the Chrystal, are *inwardly* joyned to the Particles of the Chrystal.

II. *This new Chrystallin matter is not joyned to all its planes, but for the most part to the planes of the top only, or to the extreme planes; whereby it comes to*

pass, 1. That the Intermediate planes, or the quadrilateral planes are made up of the *bases* of the extreme planes, and so the same intermediate planes are bigger in some Chrystals, in other lesser, in some altogether wanting. 2. That the intermediate planes are almost always striate or streaked; but the Extreme planes keep the marks of the matter joy-
ned to them.

III. *The ChrySTALLIN matter is not put to all the Extreme planes at one and the same time, nor in the same quantity.* Hence it is, 1. That the *Axe* of the Pyramids doth not always make one and the same streight line with the *Axe* of the *Co-
lumn*. 2. That the Extreme planes are seldom equal to one another, whence follows an inequality of the intermediate planes. 3. That the Extreme planes are not always triangular, as neither all the intermediate planes are always quadrilateral. 4. That the *Extreme solid Angle* is resolved into several solid Angles: which also often befalls the *Intermediate solid Angles*.

IV. *The Whole plane is not always cover'd w. h a ChrySTALLIN matter, but there*
are

are places left bare, sometimes toward the Angles, sometimes toward the sides, and now and then in the midst of the plane. Hence it is,

1. That the same Plane, commonly so called, hath not all its parts scituate in the same plane, but in divers, variously standing out above it.

2. That the Plane commonly so called is in many places not plane, but appears gibbous.

3. That in the intermediate Planes there arise inequalities like steps of Staires.

V. *ChrySTALLIN matter joyned to Planes upon the same planes, is by the ambient Fluid dilated, and by degrees hardned.* Whence it follows,

1. That the surface of Chrystal becomes the smoother, the more slowly the matter joyned is harden'd, and that it is left altogether rough, if the said matter be hardned, before it is sufficiently expanded.

2. That the manner may be discerned, how the ChrySTALLIN matter is joyned to Chrystal; in regard that, where it hath been concreted suddenly, it affords a surface

face full of little swellings as so many pustuls; just as the small drops of an *oily* fluid are wont to float upon an *aqueous* fluid; sometimes it represents also tri-lateral and depressed Pyramids, if it have been hardned somewhat slowly: Winding rings of the falling matter shew *both* the place, where the fluid matter did settle, *and* that place, toward which it was extended, as *also* the order of the matter conjoyned, namely, which came first, which last. And after this manner there are always found Inequalities in the Chrystals of Mountains; nor did I ever see any Chrystal, whose yet entire surfaces have that smoothness, which the broken sides of the same Chrystal, broken off, do exhibit: How much soever the Writers of Natural things enlarge themselves in celebrating the smoothness of Chrystal cut out of Mountains.

3. That all sorts of obvious solid Bodies are lock'd up in the Chrystal it self, as if they were limed there by some glue, if they have found the surface of the Chrystal not yet consolidated.

4. That it seems to have sometimes flowed down upon the neighbouring planes.

5. That

5. That in those Planes, where some places have been left without any ChrySTALLIN matter conjoyn'd, a new ChrySTALLIN matter coming and spreading it self upon the same places, formeth cavities there; at times produceth divers plates, sometimes includeth part of the external fluid, which is either meer Air, or Water with Air.

VI. *The External Fluid receiveth the ChrySTALLIN matter from the substance of the hard Bed: Whence it comes,*

1. That Stones of divers nature, sweating out divers fluids, produce ChrySTALS of different Colours.

2. That in one and the same place, sometimes the first, sometimes the last ChrySTALS become darker, but that in one and the same ChrySTAL, the parts first concreted become sometimes darker than the parts last concreted.

3. That when Oysters, and Cockles, and other Bodies, are wasted under ground, the void spaces in them are filled up with ChrySTAL.

VII. *The Motion of the ChrySTALLIN Matter, whereby it is determined towards the plains of the already form'd ChrySTAL,*
pro-

proceeds not from any common Cause of motion in the Ambient fluid, but is varied in every Chrystal; so that it depends indeed from the motion of the subtil fluid, which flows out of the already form'd Chrystal: Whereby it comes to pass,

1. That in the same place the ChrySTALLIN matter is joyned to Planes respecting the Horizon with a different scire.

2. That in one and the same Fluid Chrystals are formed of different Figures.

Whether the said Fluid be that, whereby the Refraction is made, or whether it be a Fluid different therefrom, I leave to the more Ingenious to discusse. Certainly that there is a great efficacy in a penetrating Fluid, the length of the Threds may evince, which arise out of the filings of Iron about the Poles of a Magnet; not only when those filings do closely touch the Stone, but also thorow interposed paper; where, according as the Loadstone is variously moved under the paper, so above it, such kind of Threds do *sometimes* one end of them lying still, at the other end run through all those arches that can be described within the
hemi-

hemisphere of the globe, *sometimes* wholly like so many Pike-men make a progressive motion from place to place; at *other times*, being bent by the neighbourhood of another Magnet, represent an Arch, as if every part of the filings, sticking to one another, were grown together into one solid Body. After the same manner I am apt to believe, that by means of the permeating Fluid those drops stick together, which when concreted in a *Recipient* by the matter driven out of the Retort, do first adhere to the upper part of the Recipient within, but, when store of them have touched one another in the same Arch of the Recipient, they thence falling down do forme various globular threds, sometimes by their extremities sticking to the sides of the Recipient, sometimes intangled in other Threds. Those kind of Threds, which now and then I have observed in the Aqueous humour of the Eye I should believe to be made up of globuls in like manner; nor should I think Threds and Branches to be otherwise by external apposition produced in a Fluid. But however it be in these, there is in the increase of Chrystal

to be considered a double motion: *one* which maketh the Chryftallin matter to be joynd to these and not to other places of the Chrystal; which motion, I guess, is to be adscribed to the *Permeating* subtil fluid; to be illustrated by the lately alledged Example of the Magnet: The *other*, whereby the new Chryftallin matter, joynd to the Chrystal, is spread over the Plain, which motion is to be derived from the *Ambient* Fluid. Thus, when the Iron-Threds rise up upon a Loadstone, what by the motion of the Air is struck off from one, cometh to the other. To this motion of the *Ambient*

why in Angular Bodies the opposite plains are parallel to one another.

I should attribute, that not only in Chrystal, but also in many other Angular Bodies the opposite planes are parallel to one another.

From the things hitherto discoursed it might be evinced, that an Extreme Cold is not the efficient cause of Chrystal: *Nor* that it is the *Ashes* alone, burnt by the Fire, that are changed into Glas: *Nor* the sole force of the Fire that produceth Glas: *Nor* that all Chrystals were produced in the Beginnings of things
but

but that there are still produced every Day: *Nor* lastly, that 'tis a thing above the power of Man, to discover a production of Glass without the violence of Fire, provided he will but set upon an accurate Analysis of such Stones, in whose Cavities the best Chrystals are formed. For 'tis certain, that as Chrystal is concreted in a fluid, so the same may be resolved into a fluid, if so be you know to imitate the true Dissolvent of Nature. Nor is it any matter, that some Fluid Bodies, when once the resolving Fluid or their Menstruum is thence drawn forth, cannot any more be resolved by the same or by the like Resolvent; for that happens in Bodies, out of which all the Menstruum is resolved by the force of Fire; but Chrystal and all Angular Bodies, which do concrete in the midst of a resolvent Fluid or *Menstruum*, do never become so pure, but that some Particles of the *Menstruum* remain betwixt the parts of the Angular Body: whence depends the principal cause, * that Chrystal

*How to produce
Glass without
Fire.*

* The Cause of the difference between Chrystal and Glass, in Refraction and other Operations.

differ

differs from Glass both in Refraction and other Operation; for as much as in Glass there are not any parts of the dissolving fluid, being thence driven away by the violence of the Fire: For the fluid, wherein Chrystal is concreted, is to Chrystal even as Common Water is to Salts; which might easily be proved by an Induction of those things, which the Concretion of Salts hath common with the Concretion of Chrystal. But least I should too far digress from my purpose, by enlarging upon all those particulars; I shall recite but one Experiment, which seemed to me very considerable. In one and the same Stone, the plates of it, parting in divers places from one another, were full of Chrystals, of which some were aqueous, some very shining, some white, some amethystine, mixed without any confusion of colours; just in the same manner as the Experiments, here made at *Florence* with Salts, do shew, that *Vitriol* and *Alom*, being dissolved in one and the same Water, after some of the Water is wasted, each of them coagulateth a part, without any mixture of the parts of the other.

The

The *Angular Bodies* of IRON, as many as hitherto I have met with, may be reduced to three sorts; of which the *first* is plain, and being somewhat thick in the middle, by little and little grows thinner towards the extremes, where it ends sharp all about. The *second* is included in *twelve* plains; and the *third*, in *twenty four*. Out of the second sort becomes sometimes an Angular Body made up of six plains, resembling two Trilateral Pyramids, so joyn'd by the *base* to one another, that the *Angles* of one base do bisect the sides of the other base.

The Second and Third sort of Angular Bodies of Iron do agree with Crystals;

1. As to the Place of Production; seeing that the place where Iron grows, is partly solid, partly fluid, and is the hollowness of a Stone.

2. As to the place which the matter is joyned unto; for as much as in Iron also the matter is joyned not to all, but to some certain plains, and to these not always all over, nor always at the same time, but now to one, then to another,

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some;

sometimes towards the extremes, and sometimes towards the middle.

3. As to the place whence the Iron-matter comes, since that also seems to have issued out of the pores of some solid Body.

4. As to the manner by which the same matter by means of the *permeating* fluid, is determined towards the Solid, and by the motion of the *ambient* fluid is extended into a plain, and made smooth.

They differ as to Matter and Figure. For, Chrystal-matter is diaphanous, but the matter of Iron is opaque. The Figure of Chrystal is of Eighteen plains, the twelve extremes of which plains are polished, but the six intermediate streaked: But in the Second sort of Iron there are counted Twelve plains, six whereof are the extremes and streaked, the other six the intermediate, and polished: And in the Third sort of Iron there are reckoned Twenty-four plains, the six extremes whereof are streaked, the intermediate eighteen polished, sometimes between the extreme streaked plains there lye six other shining plains, resem-

resembling the imperfect or cut-short sides of triangular Pyramids.

I have thought a thing worth consideration, that by a Cube cut-short may be exactly represented the whole number of plains in the *third* sort of the Angular Bodies of Iron: For *there* are six five-sided plains, which are coincident with the plains of the Cube, and by four angles do bisect each side of the plains of the Cube; all the other plains are found in the angles of the Cube, which after a certain manner are cut short.

There is yet another thing in the same Angular Bodies of Iron, not less to be admired, which is, That in the *Second* sort of the Angular Iron-bodies the extreme plains, that are streaked and five-sided, in progress of time are changed into three-sided ones; but the Intermediate plains, which are three-sided and polished, become five-sided, having two right-angled Angles close to one another; but betwixt every two five-sided plains, by which their eight-angled angles touch each other, there are two Triangles or two three-lateral plains likewise polish'd; so that the *Second*

sort of Iron is changed into the Third sort.

But now, that after this manner out of a Body of Twelve planes is made a Body of Twenty four planes, I conclude from hence: 1. That in the same Aggregat of Iron-bodies, almost all the thinner ones have only twelve planes, but the thicker ones, twenty four. 2. That in some Bodies of Twelve planes there appear the Beginnings of Triangular planes, which are accessory, and being continued make up a Body of Twenty four planes.

In the Triangular planes I have often observed so perfect a smoothness, that there appear'd not the least unevenness to the eye; which I never yet saw in any Chrystal: In others, I have seen lesser Circular planes put upon greater, the superiour of which were, for the most part, close to the *vertex* of the Triangle; so that it may be doubted, whether the Five-sided planes be not made up of the *bases* of the Triangular planes, considering that footsteps of streaks are *there* extant parallel to them.

That

That in *Ore* of *Copper* the Angular Bodies are formed after the same manner, as hath been said of *Chrystal* and *Iron*, may be collected from those *Copper-pieces*, which Your Highness keeps amongst other *Curiosities* of Nature: But seeing that the plenty of the matter fills up all the interstices of Bodies, 'tis hard to find out the whole Figure of Bodies.

The manner of the forming of Copper-Ore.

Not is it otherwise with the Angular Bodies of *Silver*, transmitted to Your Highness out of *Germany*.

Of Silver-Ore.

As to *Diamonds*, and the place and manner of their production; we may from their *Fabricks* infer the same, we did of *Chrystals*; namely,

Of the place and manner of the production of Diamonds.

1. That they are produced in a Fluid inclosed in the Cavities of Stones; although a famous *Writer* of the *Indies* would perswade us, that *Diamonds* in a certain number of years do grow again in the Earth, whence they were once digg'd out.

2. That they are produced in a Fluid by the apposition of *Adamantin* matter.

3. That in the production of them are to be consider'd the operations both of the permeating and ambient fluid.

But as to the *Figure*, that is various, some being comprisd in eight, others in nine, others in eighteen, and some in twenty four planes; in which last I have seen that most planes were streaked, some also smooth: And though some of them were angular, yet they had their surfaces rather gibbous than plane.

The matter of *Marcasites* puts on various figures: For now it doth incrustate the surface of a plane; at other times it is condensed into Bodies of many planes; sometimes it formeth right angled Parallelepipeds, which the vulgar calls *Cubes*; although the equality of all planes be seen in few.

Forasmuch as I have had the opportunity of observing many things of the *Cubes* of *Marcasites*, both as to the *Cubes* themselves, and the Places where they are found, I shall only speak of such. Now their production differs from that of *Chrystal*s.

1. As to the *Time*; for, the *Cubes* of

of Marcasites were produced *before* the production of the Beds, wherein they lye; but Chrystals are coagulated *after* the production of the Beds.

2. As to the Place of production: For, Chrystal, at least whilst it was concreting, was incumbent on a Solid Body, and consequently was contained in a place partly solid, partly fluid: But the Cubes of Marcasites seem to have been concreted betwixt two fluids, considering that even in the greater Cubes of them there are no marks extant of any cohætion with another body; though often there be found small Cubes, which in the concreting have come to adhere to one another in the surface of the fluid. But now, that such kind of heavy Bodies can remain on the top of a fluid, whilst one surface of them is immediately touched by a superincumbent Fluid of another nature, and lighter, the solid demonstrations of the Great *Galileo* do evince. That of the said fluids one hath been *Aqueous*, the matter of the Bed sheweth, which hath subsided out of the same Fluid.

3. As to the Manner and Place of Ap-
 F 4 . . . position,

position, in regard that the matter of the Marcasite is joyred to all the plane Cubes, otherwise than we have said it falls out in Chrystals; Which the Uniformity of all surfaces manifestly shews in the Cubes I my self have digg'd out of Stones; all the planes of which had streaks parallel to two sides, in such a manner that in the opposite planes the streaks went in the same *ductus* the same way, but the planes next to each other had streaks going different ways. From the *ductus* of the streaks it follows, that the Ambient fluid was determin'd by a three-fold motion about every Cube, whereof one was perpendicular to the Horizon, the other two parallel to it, but perpendicular to each other. Nor will it be difficult to explicate the manner of this three-fold motion: for, whilst the fluid endeavours to recede from the Center of the Earth, that direct motion is hinder'd by the *base* of the Cube; whereby it happens that the said fluid is turned towards the narrower sides, in regard that the *impetus* of the ascending fluid through the larger sides is stronger, and therefore permits no passage
that

that way ; and thus the two pairs of planes are marked with streaks : The third pair of planes receiveth its streaks from that part of the Fluid, which passeth between the Cube and the Fluid, reflecting from the *base* of the Cube.

4. As to the Perfection of the Figure: For among *Chrystals* there is very hardly one to be found, in whose shape there is not something defective, but in the Cubes of the *Marcasites* there is seldom any thing wanting. Nor is it hard to give a reason hereof; for since that in Chrystals all the solid Angles, (the extreme excepted) are obtuse, and that to each plane of them the ChrySTALLIN matter is joyned a part by it self, the said plane becomes so much the less, whilst the neighbouring planes alter the figure. But in the Cubes of a *Marcasite*, seeing that all the solid angles are right angles, although new matter be added to one plane alone, that plane ever keeps the same magnitude, the neighbouring planes not changing the figure.

Many other things are observ'd in the Cubes of *Marcasites*; as, Cubes included in Cubes, the Matter of the *Marcasite*

site cover'd with a transparent Matter, which incloseth another Marcasite, and the like other things, which I reserve for the *Dissertation* it self.

There are also Angled Bodies, that are resolv'd into plates; as Rhomboideal *Selenites's*, which are Rhomboideal Bodies, that are resolv'd into other like figured bodies; and several other Bodies, which though they differ from Chrystal in many things, yet they all agree with one another in this, that they have been concreted in a Fluid and out of a Fluid:

Talk dissolvable into a fluid Body.

which is likewise true of that most famous substance, *Talk*; so that those do not at all erre, who believe that the solid Body of *Talk* is dissolvable into a fluid body, seeing it is without controversy, that it was congeled out of a Fluid, but that those doubtless shoot quite beside the mark, that labour to extort this benefit from it by the force of Fire: For, *Talk*, being accustomed to gentler and kinder usage from Nature, disdains that cruelty, which the Votaries of Beauty exercise upon it, and out of revenge yields to *Vulcan* that part of its own Resolvent,

Solvent, which till then it kept inclosed in its Body.

If there were made an accurate *Examen* of Angled Bodies, both as to their Composition and their Resolution, we might shortly obtain a certain knowledg of the Variety of the Motion, with which the Particles of the Fluid, as well the subtil, as the ambient, are agitated: Which part of Natural Philosophy as it hath been touched by few, so it is necessary to all for the true explication of Natural operations.

Among Solids naturally included in Solids, there is none that occurs more frequently, and that hath more doubt in it, than the *Cockle-shells*: Wherefore I purpose to discourse somewhat more largely of them, considering *first* those that are taken out of the Sea; and *then* those, that are digg'd out of Mountains.

Cockle-shells largely discoursed of.

All sorts of *Shells*, that once had an animal in them, exhibit to our senses what follows:

- 1. That the whole Shells are resolved into little shells, but these little shells into

into Threds; which threds are reduced to two sorts, differing from each other in colour, substance and place.

2. That in the *little shells* the upper and under superface are nothing else but the extremes of the Threds; but the superface of the *Limbus* or Rim are the sides of the same threds scituate in the Rim of the little Shell.

3. That in the Shell it self, the interiour superface is the same with the interiour superface of the inmost or greatest Shell; but the exterior superface is composed of the exterior superface of the least Shell and of the superface of all the Lims of the intermediat Shells.

Touching the *Manner*, how Shells are produced, the particulars following may be evidently demonstrated;

1. That the Matter of the Threds is like the sweat of Animals in this, that it is an humour excreted through the exterior superface of the Animal.

2. That the Figure of the Threds may be produced two manner of ways; *either* in the very Pores of the Animal, through which they are excreted; *or* whilst the superface of the growing Animal,

mal, being made bigger than the superficies of the long since concreted little shell, recedeth from the same, and thereby partly draws into threds the glutinous humor contained between both superficies (the which is very common to viscid humors,) partly increaseth it by excreting new moisture, considering that no other matter can penetrate between the said two superficies.

3. That the diversity of the Threds depends from the difference of the Pores, to be found in the superficies of the Animal, and from the difference of the matter that is excreted by the same pores: For such kind of animals have a two-fold substance in their superficies, whereof one is harder, the other softer, both fibrous; the more accurate investigation of which brings no smal light to Osteology, or the Explication of Bones.

Considerable light for the Explication of Bones.

4. That all little Shells, the outermost or smallest excepted, are produced between the exterior shell and the very Body of the Animal, and consequently have receiv'd their figures not from themselves,

selves, but from the place; whence it comes to pass, that the motion of the animal and the quantity of the matter do often produce some variety of figure in Oysters. Of the *outer-most* little shell it may be doubted, whether the Ambient fluid have *touch'd* the exterior surface, or whether it have been *cover'd* by a membrane. For my part, I am apt to believe, that the latter only can be true: 1. Because that the threds of all the other little shells at the time of their concretion were not touch'd by the Ambient fluid. 2. Because that in the hairy round Shel-fishes (called by the Latins *Chama*) we see, that something like a membrane or leather doth outwardly cover the Shells. But the question is about an almost unsensible thing; and it may be said, that the threds of the first little shell were then hardned when they were yet within the Egge; it being certain by experience, that Oysters and other testaceous animals are bred of Eggs, and not of putrid matter.

Testaceous Animals bred of Eggs, not putrid matter.

From what hath been said, may easily be explained, 1. All that variety of Colors

Colors and Pricks, which are wondred at by many both in our own and in outlandish shells; seeing it proceeds from nothing else, than from the *limb* or rim of the animal included in the shell. For this lim, whilst from a small one it is by little and little growing and dilating it self, it leaveth in each rim of the little shells its image; forasmuch as the said rims are *either* concreted out of the moisture, which sweats out of the lim of the animal; or are the lims themselves of the creature, which, as the Teeth in Sea-Dogs, do perhaps grow up a new in the place of the former rim, and, in the manner of the same teeth, are by little and little thrust outward.

2. The Production of *Pearls*, The manner of the production of Pearls, both more and less round ones. both of those, which adhering to the shells, are not so very round, and of those, which, when the orifices of the pores are obstructed in the superface of the Animal, acquire a round figure within the pores themselves: For between the *coats* of the Pearls, and the *shells* of the Pearl-bearing Cockles there is only this difference, that the threds of the shells are as
 'twere

'twere scituate in the same plane; but the coats of the Pearls have their threds disposed all over the same spherical surface. A very fine instance whereof was afforded us by one among those, that were at the command of Your *Highness* broken by me, which being white without, did include within, a black body like a grain of Pepper both as to colour and size; in which was most evident the scituation of the threds, by one extreme respecting the center; wherein also the orders and spheres of the same threds could be discerned. On the same occasion I saw, 1. That Pearls, which are unequal by many little knobs, are nothing else than many little Pearls inclosed by the same common crust. 2. That many yellowish Pearls are tinged thus yellow not only in the outward *what possible* surface of the sphere, but *ty there is of* also in all their interiour *making yellow* spheres; so that it needs not *Pearls white,* to be doubted any longer, that *and of imita-* that colour is to be adscribed to the changed humors of the animal, and that he *ting Pearls.* washeth the Blackamore, that taketh pains to wash it out, unless the colour be adven-

adventitious, by wearing the Pearl about the Neck, or only such in the outermost yellow sphere, the humors of the Animals not yet being changed at the time when the internal spheres were formed. Whence their error is manifest, who without consulting Nature will imitate the forming of Pearls by their phancy; whereas hardly any one hath attempted it with success, except he have, like another *Lucullus*, replenisht Ponds with Pearl-bearing shells, or have searched in the animals themselves for the ways of multiplying them, or thence learn'd the difficulty of imitating Nature's Works. I will not deny, that there may be made little globuls by art, composed of various tunicles or coats; but to dispose the coats out of a row of threds joyn'd to one another, whence that native brightness of Pearls depends, that is the thing, which I judge most difficult to effect.

The *Shells* that lye under ground, may be reduced to *Shells under ground.* three sorts.

The *First* is of those, that are so like to those lately described, as an Egg is to an Egg; forasmuch as the *Shells* them-

G selves

selves are resolved into *little Shells*, and the little Shells into Threds, and there is the same difference in the Threds, as also the same position or scite. That these Shells were once the parts of Animals living in a Fluid, though there never had been seen any Testaceous Marine Creatures, the very view of the Shell it self evinceth, as may be evident by the Instance of *Bi-valve Cockle-shells*.

At the time that the *Bi-valve Cockle-shells* were formed, the matter, contained within them,

1. Had a smooth surface, having innumerable pores, and two different sorts of pores.

2. It had a flexile substance, and less hard than the Shell it self.

3. It communicated with the ambient matter on one side, but had no commerce with it on the other.

4. It did by little and little recede from that side, where the communication with the external matter was denied it, towards that side, where it had that commerce with the same matter free.

5. It hath been able by intervals to open it self according to the wideness of the

the angle, which the hinges of the Shells admit.

6. Of small it is become great.

7. It hath transmitted the matter, whence the little Shells are made, thorough its own substance.

The *External Matter* environing the Cockle-shells, 1. If it was not altogether fluid, at least it had less force to resist, than the matter contain'd within the Cockles had of expanding it self. 2. It contained a fluid matter fit to make of it threds of little shells: All which conditions both of the internal and external place, being in the *Dissertation* it self demonstrated by arguments and figures, do sufficiently evince, that there was an animal within the Cockles, and a Fluid without the Cockles.

The *second* sort is of those Shells, which in the rest are like to the lately described ones, but differ from them only in colour and weight; in regard that some of them are found too light, others too heavy, forasmuch as *these* have pores fill'd up with an adventitious juyce, but the pores of *those* are widen'd by the expulsion of the lighter parts: Which I

I shall say no more of, they being nothing else but either petrify'd or calcin'd Shells of animals.

The *Third* sort is of such as in their figure alone resemble those, that were newly discours'd of, but for the rest totally differ from them, seeing that in them are to be found neither the little Shells, nor the Threds, much less the diversity of the Threds. Of these some are *Aereal*; some *Lapideous*, of either a black or yellow colour; others *Marbly*, others *Chrystallin*; others of other matter; the production of all which I explain in manner following.

Where the penetrating force of juyces hath dissolved the substance of the Shell, the same juyces being either drunk up by the Earth have left the spaces of shells void (which I call *Aereal* Shells,) or being alter'd by new adventitious matter, have, according to the variety of that matter, fill'd up the same spaces of shells either with Chrystal, or Marble, or Stone: Whence comes that very pretty kind of Marble called *Nephiri*, which is nothing else but a sediment of the Sea full of all sorts of Shells, where the substance of the

the

the Shels being wasted, a stony substance is come into the place thereof.

My design of being short here, will not allow me to make a Description of all those particulars, which I have found observable in every sort of Shels digg'd out of the Earth; wherefore, leaving other things, I shall only relate here what follows;

1. That there was found a Pearl-bearing shell in *Toscany*, a Pearl yet sticking to the Shell.

2. A piece of the greater Sea-nacre, (*pinna marina*,) in which, the silk like substance within the Shell being consumed, the colour of that substance did remain in that Earthy matter, which had fill'd the Shell.

3: Likewise some Shels of Oysters of a strange bigness, wherein are found many oblong cavities suppos'd to be eaten out by Worms, altogether like those, which in the *Anconitan*, *Neapolitan* and *Sicilian* Stone are inhabited by a kind of Snail; which hollowneses of Stones if they be not made out of dirt by some Insects making their nests, (which I scarce believe, seeing that the very substance of

the middle part of the Stone, where no cavities are found, is the same with the substance of the cavities, which are all about the superficies,) they are certainly eaten out by Worms; as both appears by the superficie of the cavity, and is evinced by a certain body found in many cavities, woven together out of pretty thick filaments, which Body in size and shape answers to the cavity it self. Certainly they are not made by the Snails, nor about the Snails, seeing that such testaceous fishes have no organs fit to gnaw, nor doth any cavity answer to the figure of the shells. Nor is it a wonder, that Stones exposed to the Sea should in the said cavities harbour Shell-fishes Eggs thrown out by the Sea, since I have hitherto seen none of them that was destitute of a manifest out-let. If any one shall say, that those cavities were produced by a lapidescent juyce concreted about certain bodies, I answer, that then there would have been found some cavities every where overlaid with the same matter *without* an out-let.

4. More-over, a Shell in part wasted inwardly, where a marbly crust, cover'd
with

with many *balanus's*, did supply the loss of the consum'd substance: so that we may certainly conclude, that this Shell was by the Sea left upon the Land, and was carried back into the Sea, and again cover'd with a new sediment, and then left by the Sea again.

5. Also some very small Eggs, and Turbinated Shells hardly visible but by a Microscope.

6. Likewise some Scollops, *Turbo's*, and Bi-valve Cockles, not cover'd with Chrystal, but Chrystallin in their whole substance.

7. Various tubulous Shells of Sea-worms.

What hath been said of Shells, the same is to be said of other parts of Animals,

and of the Animals themselves buried under ground: of which number

are the *Teeth* of *Sea-Doggs*, the *Teeth* of the *Fish Aquila*, *Fishes Back-*

Bones, all sorts of *whole Fishes*, *Skulls*, *Horns*, *Teeth*, *Thigh-*

Bones, and other bones of Terrestrial Animals; considering that all these either quite resemble the true parts

Other parts of Animals found under ground.

Teeth of Sea-Dogs, Fishes, Skulls, Horns, Bones, &c.

of animals, or only differ from them in weight and colour, or have nothing common with them but the outward figure only.

There occurs a great difficulty in that vast number of *Teeth*, which every Year are brought out of *Maltha*; seeing that almost no Ship goes thither, but it brings back some of them. For my part, I can find no other answer to that difficulty but this: 1. That such Sea-Dogs have, each of them, sixty teeth, and more; and that all the time they live they breed new teeth. 2. That the Sea agitated by the Winds is wont to protrude those bodies, it meets with, towards some one place, and there heap them together. 3. That Sea-Dogs go by Flocks, and consequently that the Teeth of many Dogs may have been left in one place. 4. That in the Lumps of *Maltha*-Earth, brought hither, besides the several Teeth of divers Dogs, there are also found sundry Cockle-shells; so that, if the *Number* of the Teeth should incline a Man to ascribe their production to the Earth, on the other hand the *Make* of the same teeth, and the abundance of them in every animal, and the

the Earth like the bottom of the Sea, and other Marine Bodies found in the same place, do favour the contrary opinion.

Others find a difficulty in the bigness of the *Thigh-bones*, *Skuls*, *Teeth*, and other Bones, digg'd out of the Earth. But

Bigness of Thigh bones, Skuls, &c. found under ground.

neither is this Objection so considerable, as that the unusual bigness should make us conclude it to be a size beyond the power of Nature: For, 1. In our Age there have been seen Men with very long faces. 2. 'Tis certain, that there were once Men of a monstrous bigness. 3. Often those are believed to be Humane Bones, that are Bones of other Animals. 4. 'Tis the same thing, to ascribe to Nature the production of Bones truly fibrous, and to say, that Nature can produce the Hand of a Man without the rest of the Man.

Some there are, to whom it seems, that the length of time overthrows the force of all the other Arguments; considering that 'tis recorded by no Age, that Inundations have gone up so far as those places, where now many Marine Bodies are found, excepting the Universal Deluge; from the time of which there are reckon'd

reckon'd about 4000 Years to these our days: Nor doth it seem consonant to reason, that the part of an Animal Body should so long resist the injuries of so many Years, since we see, that often within the space of a few Years the same Bodies are destroy'd totally. But this Objection may easily be answer'd, by saying, that that whole business depends from the diversity of the Soil: For, I have seen Beds of a *Clayie* kind, which by the thinness and fineness of its juyce did resolve all Bodies inclos'd in it; but I have observed *Sandy* Beds, which preserved all Bodies lodged therein; by which experiment we may be led to the knowledg of that juice, which resolveth solid Bodies. But that 'tis certain, that the production of many Shells, we meet with in our days, is to be referr'd to the times coincident with the General Deluge, the following argument evinceth.

Shells found in our Days as old as the universal Deluge.

Tis certain, that before the foundation of the City of *Rome*, the Town of *Volaterra* was then already powerful; but in those huge Stones, which in some places are found there (being the remainders

ers of very ancient Walls,) there are found all sorts of Shells ; and not long since, in the middle of the Market-place, there was cut out a Stone full of streaked Cockles ; so that 'tis indubitable, that the Cockles, now found in the said stones, were already produced at that time when the *Volaterran* walls were rais'd. And least it should be said, that the Shells alone, being turn'd into stone, or included in stone, had suffer'd no damage by the wastful time ; 'tis to be noted, that the whole Hillock, on which the most ancient Town of the *Etrurians* is built, riseth out of the sediments of the Sea, laid on one another, and parallel to the Horizon ; where many Beds not stony do abound with true Cockles that have suffer'd no change at all : So that we may confidently say, that those Cockles, which at this day we have drawn from thence, and that are unchanged, have been produced Three Thousand Years ago, and more. From the building of the City of *Rome* until these times we reckon about 2420. Years : And who will not grant that many Ages elapsed from the time that the first People seated themselves there, until the

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the place grew to that bigness, and power, it had at the time when *Rome* was built? To which Ages, if we shall add that time, which passed from laying the first sediment of the *Volaterran* Hillock, to the time when the same was relinquish't by the Sea, and the Aliens there settled, we shall easily come up to the very times of the Universal Deluge.

The same authority of History will not let us doubt, that those vast Bones, which are digg'd up out of the *Aretine* Fields, have lasted 1900. Years; it being certain, 1. That the Skuls of labouring Beasts, found there, are not of Animals of this Climat, as neither are those huge Thigh-bones, and long Shoulder-blades, met with in the same place. 2. That *An-nibal* pass'd there, before he gave Battel to the *Romans* at the Lake of *Thrasimene*. 3. That in his Army there were *African* Beasts, and huge Turret-bearing Elephants. 4. That, when he came down the *Fesulan* Hills, there perish'd by the Waters in the Marishes the greatest part of the loden Animals. 5. That the place, whence the said Bones are digg'd, was heaped up by various Beds, that are full

of

of Stones thither devolved from the circumjacent Mountains by the impetuouſneſs of Torrents. So that every one, that ſhall but compare the condition of the place, and the Kind of the Bones with the Hiſtory, will find all things evidently agree together.

What is ſaid of Animals and their parts, ſuteth likewiſe with *Plants* and the parts of *Plants*, whether they be digg'd out of Earthen Beds, or lodged within ſtony ſubſtances. For *either* they do altogether reſemble true *Plants* and their parts (which are rarely found,) *or* they differ from them only in colour and weight, (which do occur more frequently, either burnt into *Cole*, or impregnated with a petrifick juyce,) *or* they only answer them in figure, of which there is great abundance in many places.

Of Plants under ground, or inclos'd in ſtony ſubſtances.

Of the two firſt ſorts it is not to be doubted that once they were true *Plants*; the texture of the Bodies themſelves evincing it, and the condition of the place, where they are digg'd, not diſagreeing thereto. Thoſe that object, that Earth transported into Houſes in proceſs of time

time is changed into Wood, can only affirm *that* of the Earth's superface, including the Wood; where the Earth, dried in time and crumbled into dust, discover'd the Wood inclosed therein: Neither do they urge, that in the pores of the same Wood there have been found Metallick threds; whereas I my self have pull'd out of the Earth a stem, which by the Knots of the boughs, and by the Bark appear'd to be a Plant, whose crevaces were fill'd with a Mineral matter.

*Light to the
Doctrine of
Minerals.*

From hence also might no small light accrue to the Doctrine of Minerals, if inquiry were made in *Wood*, and in the *place* of Wood, what they may contribute to the production of Minerals. Many things pass under the name of *Bitumen*, of which yet it may be evinced by the *ductus's* of fibres, and the ashes of them when burnt, that they are nothing but Coles.

The *third* sort hath more difficulty in it, I mean the *Figures* of Plants impress'd by nature upon Stones; forasmuch as we observe such kind of Figures in Hoarstoft, the Mercurial Tree, several Volatil Salts,

Salts, and a white substance resolvable into Water, which in Glass-vessels not only comes to stick on the sides within, but sometimes from the middle of the bottom riseth up into the Air.

But all being well consider'd, there is nothing in all this, that's contrary to the deliver'd opinions. To shew which, we may take notice, that the Figures of Plants to be found upon Stones are reducible to two sorts; *some* are seen only in the superface of the crevaces, which I will easily allow were produced without any true Plant, though not without a Fluid; *others* do not only appear in the superface of the rifts, but spread their little ramifications every where thorough the very lapideous substance it self; whence it follows, that, at the time when the said Plant was produced, whether that were done after the way of other Plants, or after that of a Mercurial Plant, the very substance of the Stone had not then yet ceased to be a Fluid: Which is further confirm'd not only by the very, somewhat yet left, consistence of the Stone, but also by the Angular Bodies that are frequent in the *Dendroitis* of
Elva,

Elva, which do never concrete but in a free fluid. But what need of other Arguments, when Experience it self speaketh? I have visited and view'd divers *ousy* places, both above and under ground, where stones, growing by the præterfluent Water unto Mosse and other Plants, were cover'd with new Mosse of several kinds.

Hitherto I have discoursed of the chief Bodies, whose *place*, where they are found, hath made many doubt of the place of their production; and on that occasion I have withall intimated, how from that which is sensible, something certain may be concluded about that which is not sensible.

But now, How the *Present* state of a thing may discover *Various changes that have happen'd in Tusca* the *Former* state of the same, will particularly appear by the Example of *Erruria* or *Toscany*; in the present face whereof those obvious inequalities afford manifest arguments of the several Changes that have happen'd therein: Which I shall here reckon up by an inverted order, and a retrogradation from the last to the first.

I. Some-

1. Sometime the inclined Plane **A** hath been in the same Plane with the higher Horizontal Plane **B**, and the rim of the same Plane **A** thus raised, as also the rim of the higher Horizontal Plane **C**, have been further continued, whether the lower Horizontal Plane **D** have been in the same Plane with the higher Horizontal Planes **B**, **C**, or whether there have been another solid Body propping up the naked sides of the higher Planes; or, which is all one, in the place where at this day are seen Rivers, Lakes, depressed plainnesses, Precipices, and inclined Planes between sandy Hillocks, all those were anciently Planes, and at that time the Waters, both of Rains and Springs, did either cover that same Plane, or open'd to themselves subterraneous Channels under the Plane; at least there were cavities under the superiour Beds.

2. At the time when the Plane **B**, **A**, **C**, and the other Planes under it were formed, the whole Plane **B**, **A**, **C**, was cover'd with Water; or, which is all one, the Sea hath once been raised above the Sandy Hills, or Downs, how high soever.

3. Before the Plane **B**, **A**, **C**, was formed,

H med,

med, the Planes F, G, had the same scite, they obtain now; or, which is all one, before the Beds of the Sandy Hillocks were form'd, there were in the same places deep Vallies.

4. Once the Inclined Plane I. was in the same Plane with the Horizontal planes F, and G, and the naked sides I, and G, were either continued farther, or there was existent another solid, propping up the same naked sides, when the said Planes were form'd; or, which is all one, where at present, Vallies are seen between the plane tops of highest Mountains, there was once a continued Plane, under which were made vast cavities, before the ruines of the superior Beds.

5. When the Plane F, G, was form'd, the Aqueous fluid was incumbent on it; or, which is all one, once the plane tops of the highest Mountains were cover'd with Waters.

Hence it is, that we may distinguish Six distinct casts of the Country of *Etruria*, and that it hath been twice Fluid, twice Plane and Dry, and twice scabrous and Craggy. Which as I make it out to be true of *Etruria*, from many places
atten-

attentively view'd by me; so I confirm it to be true of the *whole Earth*, from the Descriptions of many places deliver'd by divers Authors. But lest there should be apprehended any danger in the novelty, I shall in short lay down the agreement of *Nature* with *Scripture*, reciting withall the chief difficulties, that may be rais'd about each Face of the Earth.

As to the *first* Face, *Scripture* and *Nature* agree in this, that all was cover'd with Water; but how it began to be thus, and when, and how long 'tis continued so, Nature is silent, *Scripture* is not. But that that Fluid was Aqueous, at the time when there were yet no Animals nor Plants, and that it cover'd all, the *Beds* of the higher Hills, containing no heterogeneous bodies at all, do evince; whose *Figure* speaks that there was a Fluid, and the *Matter*, that there were no heterogeneous Bodies; but the *likeness* of the Matter and Figure in the Beds of divers and distant Mountains shew, that Fluid to have been Universal.

If any one shall say, that the heterogeneous Solids contain'd in those Beds have been in length of time consum'd, it

cannot be deny'd, that there would have been a conspicuous difference observable between the Matter of the Bed, and the Matter percolated through the pores of the Bed, and filling the spaces of the wasted Bodies. But if upon the Beds of the first Fluid there should in some places other Beds be found stuffed up with different Bodies, thence would follow nothing else than that upon the Beds of the first Fluid there were deposed new Beds from another Fluid, the matter of which new Beds might have filled the ruines of the Beds that were left by the first Fluid: so that we must always recurr to this, that at the time when those Beds of simple matter, and which are obvious in all Mountains, were form'd, the other Beds were not yet extant, but all were cover'd by a fluid, destitute of Plants, Animals and other Solids: which Beds being of that kind, which none can deny but that they may have been immediatly produced by the First Mover, we do acknowledg a manifest consent between Scripture and Nature.

Of the *second* Face of the Earth, which was Plain and Dry, Nature is likewise silent,

lent, when and how it began, but the Scripture is not so: Mean time, that there was once such a Face of the Earth, Nature affirms, and Scripture confirms, for as much as it teacheth, that Waters arising from one Spring did water the whole Earth.

Of the *Third* Face of the Earth, which was Craggy, neither Scripture nor Nature determines, *when* it began. Nature indeed shews, that that Inequality was great; and the Scripture maketh mention of Mountains at the time of the Deluge; but at *what time* those Mountains, which the Scripture there speaketh of, were produced; whether they were the same Mountains with those of this time; whether in the beginning of the Deluge there was the same depth of Valleys that now is, or whether, for depressing the surface of the much growing Waters the new breaches of Beds did open new gulfs, neither Scripture nor Nature decideth.

The *Fourth* Face, when all was Sea, seems to have more difficulty in it; although indeed it be all easy. That the Sea hath been higher, than now it is, the

production of the Hillocks out of the sediment of the Sea sheweth; and that not only in *Etruria*, but in very many places remote enough from the Sea, whence the Waters fall towards the Midland Sea; yea in those places also, whence the waters flow into the Ocean. How great that height of the Sea hath been, where Scripture determines it, Nature contradicts it not; forasmuch as, 1. There are certain marks of the Sea extant in places, which are many hundred feet high above the surface of the Sea. 2. It cannot be denied, that, as all the Solids of the Earth were in the beginning of things cover'd with an aqueous Fluid, so they may have been cover'd with it again, in regard that the change of natural things is indeed continual, but there is no Natural Annihilation. But who hath search'd into the structure of the Bowels of the Earth, so as to dare to deny that there may be vast spaces, now filled with an Aqueous, at an other time with an Aereal Fluid? 3. Let it be uncertain, what was the depth of the Valleys in the beginning of the Deluge; but let reason perswade, that in the first Ages of the
World

World there were eaten out lesser cavities by the Water and Fire, and consequently that thereupon follow'd less deep ruines of Beds : But the highest Mountains, mention'd in Scripture, were the highest of those Mountains, that were to be found at that time, but not of those at this day. 4. If the motion of an Animal can effect, that, according to pleasure, places that are now overwhelm'd with Water, shall be rendred dry, and by and by drown'd again by new waters; why should we not be ready to grant to the First Mover of all things the like liberty and the like power? About the Time of the *Universal Deluge*, Civil History is not repugnant to Sacred, reciting all things concerning it particularly. The ancient Towns of *Etruria* extend their Foundation to above Three Thousand Years; of which Towns some are built on Hillocks produced by the Sea: But in *Lydia* we approach nearer to Four Thousand Years; whence it may be inferr'd, that the time, when the Earth was relinquish't by the Sea, is conforme to the time, which the Scripture mentions.

What concerns the Manner of the *growing* Water, we may alledg many ways futable to the Laws of Nature. If it shall be said, that in the Earth the Center of *Gravity* is not always the same with the Center of the *Figure*, but that now and then it recedes from one or the other side, according as the subterraneous cavities are grown in divers places; 'tis easy to render a reason, why the Fluid, which in the beginning of things covered all, left certain places dry, and return'd to them again. With the same

*An easy Ex-
plication of the
General Deluge.*

case may be explain'd the *General Deluge*, if we place about the Fire in the middle of the Earth a Sphere of waters, or at least certain Receptacles of them; whence, without the motion of the Center, the powring forth of the included Water may be deduced. But the following way seems also very easy to me, whereby both a lesser depth of Vallies, and a sufficient quantity, of Water is found, without respect had to the Center either of the *Figure*, or of the *Gravity*. For, if we shall admit, 1. That by the fallen fragments of some Beds the passa-

ges

ges were obstructed, by which the Sea, penetrating into the hollowneses of the Earth, sends the Water to the heads of Springs; 2. That the Water, which is undoubtedly included in the bowels of the Earth, was, by the force of the acknowledged subterranean fires, partly driven towards the Springs, partly thrust forth, through the pores of the not yet drown'd Earth, into the Air; but that that Water, which *both* is ever inherent in the Air, *and* was commix't with it in manner aforesaid, was fallen down in Rain; 3. That the Bottom of the Sea was rais'd up by the dilated caverns under the Earth; 4. That the remaining cavities in the surface of the Earth were fill'd up with earthy matter, worn off from higher places by the continual afflux and washing away of Rains; 5. That the very surface of the Earth was less unequal, as nearer to its beginning: If, I say, we shall grant these particulars, we shall grant nothing contrary to reason nor daily experience. What did happen in the surface of the Earth whilst it was cover'd with Water, neither Scripture nor Nature declareth; this only we

we may affirm from Nature, that deep Vallies were then produced : 1. Because that the Cavities being by the force of Subterraneous Fires made more spacious, gave place to greater ruines. 2. Because that a return was to be open'd for the Waters into the deeper parts of the Earth. 3. Because that at this Day in places remote from the Sea are found deep Vallies fill'd with many marine Sediments.

In the *Fifth* Face, which, the Earth being made dry again, did shew vast Plainnesses, Nature demonstrateth, that those Plainnesses did exist, and the Scripture contradicteth it not. Mean time, whether the whole Sea did presently recede; or whether in several ages new Gulfs being open'd gave occasion to discover new Countries, since Scripture is silent hereof, and the History of Nations about the first Ages from the Deluge is doubtful to the Nations themselves, and hath been believed full of Fables, we may not determine any thing certain thereof. Yet this is certain, that a great parcel of the Earth is every year carried into the Sea (as is obvious to him, that shall consider
the

the largeness of Rivers, and the long passages through the Midland Countries, and the innumerable number of Torrents; in a word, all the declivities of the Earth) and consequently that the Earth carried away by the Rivers and joyned to the Sea-shores does every day leave new Lands fit for new Inhabitants: Which is confirm'd by the Opinion of the Antients, which saith, that whole Regions were the gifts of Rivers of the same name; as also by the Tradition of the *Greeks*, importing, that Men coming down from the Hills by litle and litle, settled themselves in the Maritim places, barren by reason of their too much moisture, but in time made fruitful.

The *Sixth* Face of the Earth is obvious, whereby the said Plainesses were chiefly by the erosion of Waters, sometimes also by the exustion of Fire, changed into various Channels, Vallies and Precipices. Nor is it to be wonder'd, that Historians have not recorded it, at what time every such change hath happen'd; for, the History of the first Ages after the Floud is confused and dubious amongst Profane Authors; and in after-Ages they under-

undertook to write and celebrate the Actions of renown'd Men, and not the wonders of Nature. Mean time we want the Records, quoted by Authors, of those that have written the History of Changes fallen out in divers places; and since other Writers, whose Monuments have been preserv'd, do speak of and reckon among Prodigies, Earthquakes, Eruptions of Fires, Inundations of Rivers and Seas, as happen'd almost every year; 'tis evident, that in 4000 Years there have happen'd many and various Mutations. So that those do much mistake, who affirm, that in the writings of the Antients there are many errors, because (forsooth) there

Not all what is dissonant in the old Geography from the modern, presently false.

occur many things in them dissonant from the modern Geography. I would not give credit to these relations, which are fabulous in Antient Writers; but there are many things to be met with in them, which also I would not disbelieve. For, of that kind I there find divers things, whose falsity rather, than verity seems dubious to me; such as are, *That the Mediterranean Sea was sever'd from the Western Ocean; That there*

there was a passage out of the *Mediterranean* into the *Red Sea*; the *Submerſion* of the *Atlantid* *Iſland*; And the *Deſcription* of many places in the *Expeditions* of *Bacchus*, *Triptolomus*, *Ulyſes*, *Aeneas*, and others, may be true, though it agree not with things as they are at this Day. In the *Differtation* it ſelf I ſhall employ evident *demonſtrations* to evince moſt of the *Changes*, that have happen'd in *Etruria* in all that *Tract*, which lyeth between the *Rivers Arno* and *Tiber*; and though the time, in which every one came to paſs, cannot be assigned, yet I ſhall bring ſuch *Arguments* out of the *History* of *Italy*, that no ground of doubt ſhall be left behind.

And this is a ſuccinct, not to ſay a *tumultuary* relation of the chief things, which in the *Differtation* it ſelf I intended to explain both more *diſtinctly* and more *largely*, together with a *Deſcription* of the places, where I had obſerv'd every particular.

Explication of the Figures.

WHereas the brevity of an hasty Writing hath made me deliver some things less clearly, especially where I speak of *Angular Bodies* and the *Beds of the Earth*; I have, for some more clearness, annexed here a few Figures chosen out of many.

The *thirteen* first figures, designed to explain the *Angular Bodies* of Chrystal, are reducible to two *Classes*;

The *first* contains *seven* differences of a Plane, in which is the *Axis* of the Chrystal. In the *1st*, *2^d*, and *3^d*, the *axes* of the parts, out of which the body of the Chrystal is composed, do constitute one straight line, but by an intermediate column, which in the *1st* figure is wanting, but is seen shorter in the *2^d*, and longer in the *3^d*. In the *4th* figure the *axes* of the parts constituting the body of the Chrystal, do not make one straight line. The *5th* and *6th* figure are of the kind of those, of which I could have produced innumerable, to evince, that in the Plane of the *axe*, both the number and length of the sides are variously changed without change in the angles, and that in the very midst of the Chrystal there are left various cavities, & formed various plates. The *7th* figure doth shew in the plane of the *axe*, how from the new Chrystallin matter laid upon the planes of the pyramids, both the number and length of the sides are variously sometimes increased, sometimes lessen'd.

The

The *second Classis* contains *six* differences of the *Basis* of a Plane. In the *8th*, *9th*, *10th*, and *11th* figures, there are only *six* sides; yet with this difference, that in the *8th* figure all the sides are equal; in the *9th* and *11th*, not all but only the opposite sides are equal; but in the *10th*, all opposite sides are unequal. In the *12th* figure, the Plane of the *base*, which should be hexagonal, contains twelve sides. The *13th* figure shews, how, by laying a new ChrySTALLIN matter upon the planes of the Pyramids, sometimes the length of the sides, and the number also are variously changed in the plane of the base, without changing the angles.

The *six* following figures do explain two divers kinds of Angular bodies of *Iron*. The *14th*, *15th* and *16th* figures serve to explain those Angular bodies of *Iron*, that have *twelve* planes; & of them the *14th* figure represents all those *12* planes laid out in one plane, *six* of which are triangular and polish't; the other *six*, pentagonal and streaked. The *15th* figure is the plane of the *base* of the same body. The *16th* figure is the plane of the *axis* of the same body.

The *17th*, *18th* and *19th* figure serve to explain those Angular bodies of *Iron*, that have *thirty* planes; and of them the *17th* figure exhibits all those *30* planes, explicated in one plane; *six* of which are pentagonal and polish't; *twelve* are triangular, polish't likewise; *six* are triangular and streaked; and *six* are quadrilateral oblong and polish't. The *18th* figure is the plane of the *base* of the same body. The *19th* is the plane of the *axe* of the same body. The

The *six* last figures do *both* shew, how from the present face of *Etruria* we may collect the six distinct faces of the same Country, above discoursed of, and serve also for the more easy understanding of the particulars, we have deliver'd concerning the *Beds* of the Earth. The *pricked* lines represent the *Sandy* beds of the Earth, so nominated from their *main* matter, there being mix't with them divers both *Clayie* and *stony* beds. The other lines represent the *Stony* beds, likewise so called a *potiori*, seeing there are Beds found in them that are of a softer substance. In the *Dissertation* it self I have explain'd the Letters of the figures, in that order wherein the figures follow one another: Here I shall only reckon up in short the order of the change.

The *25th* figure exhibits the perpendicular Plane of *Etruria*, at the time when the *Stony* Beds were yet entire, & parallel to the horizon.

The *24th* shews the vast cavities eaten out by the force of Fire and Water, without any breach in the upper Beds.

The *23th* represents, how Mountains & Valleys came to be made by the ruine of the superior Beds.

The *22th*, that by the Sea new Beds were made in the said Valleys.

The *21th*, that of the new Beds the lower ones were consumed, the uppermost remaining untouch't.

The *20th*, that by the breach of the superior sandy Beds there were produced Hillocks and Vallys.

F I N I S.

